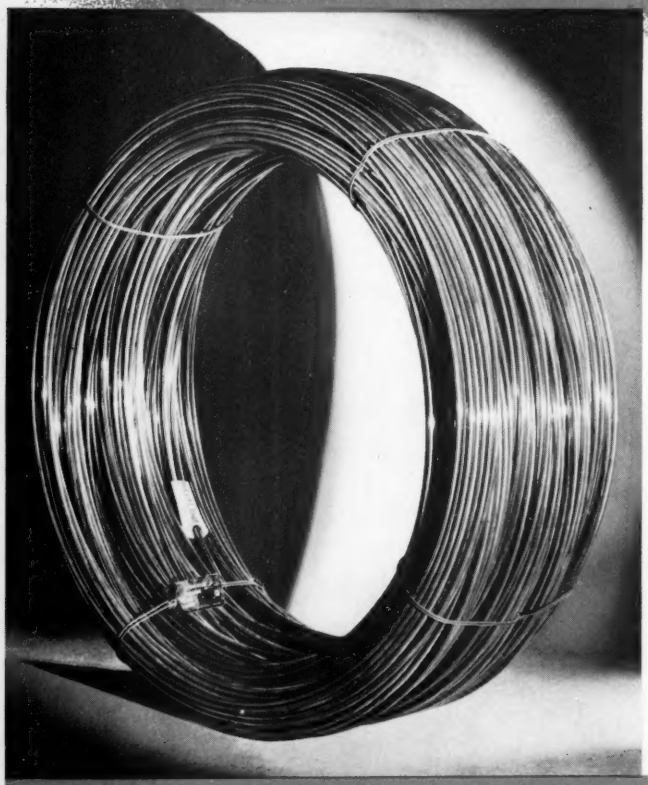
WIRE AND WIRE PRODUCTS

OCTOBER 1939

WILL YOU SPEND 3¢



TO IMPROVE YOUR PRODUCT . . . AND CUT ITS COST?

That is just what it will cost you — the price of a postage stamp — to send us your specifications — to tell us what wire products you make.

We, in turn, will submit our recommendations and quotation. If the result is your use of Republic Wire with the improvement in product quality and reduction in costs experienced by many other Republic Wire users, your 3 cents certainly will be well invested. Address Republic Steel Corporation — Wire Division, 7850 So. Chicago Ave., Chicago, Ill. — or General Offices, Cleveland, Ohio.

REPUBLIC WIRE

REPUBLIC STEEL
REG. U. S. PAT. OFF.

UNION DRAWN STEEL DIVISION
BERGER MANUFACTURING DIVISION
NILES STEEL PRODUCTS DIVISION
STEEL AND TUBES, INC.
TRUSCON STEEL COMPANY

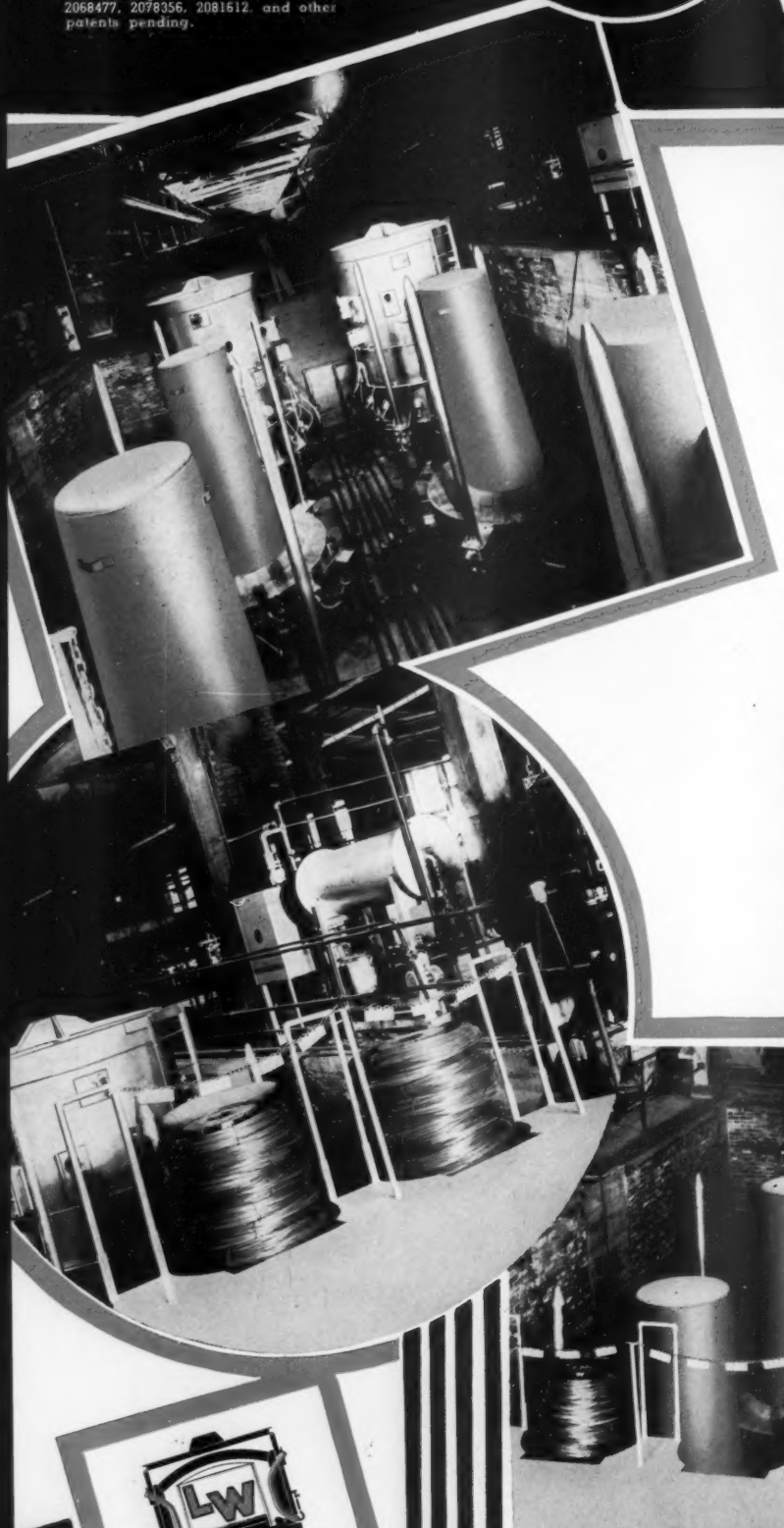
Basic Open Hearth and Bessemer (Annealed, Regular, Hard Drawn, Sul Coated, Bright, Extra Bright, Copper Coated, Liquor Finish, Galvanized), Spring Wire, *ENDURO Stainless Steel Wire, *Toncan Copper Molybdenum Iron Wire, Cold Heading Wire, Wire Rods.

*Reg. U. S. Pat. Off.

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

This is only 1/2 OF THE WIRE ANNEALING INSTALLATION at WICKWIRE BROTHERS Company

The Wilson Annealing Unit is covered by Patents Nos. 1952402, 2068477, 2078356, 2081612, and other patents pending.



THESE two WILSON Wire Annealing Units had only been in service seven weeks at the Wickwire Bros. Co., Cortland, N. Y., when two additional units were ordered.

The successful bright treatment of wire coils from 24" block to 8" block and the exceptional uniformity of annealing has justified this action on the part of Wickwire Bros. Co.

Similar opportunities for such savings and improvement in practice may be present in your plant. If you will send for one of our wire annealing specialists, we will show you how Wilson Annealing service can produce the same results for you.

An Exclusive Development of

LEE WILSON ENGINEERING CO.

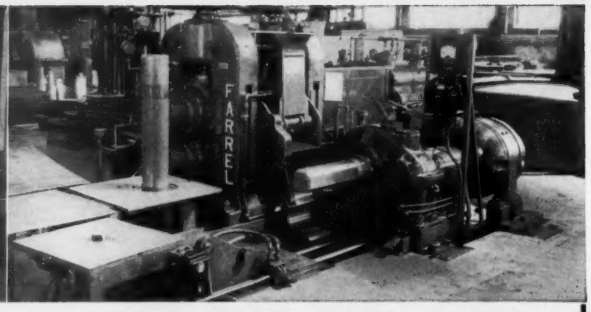
1370 Blount Street • Cleveland, Ohio

SOLD BY THE WEAN ENGINEERING CO., INC., WARREN, OHIO

DETROIT
NORTON SERVICE
DISTRIBUTION...
the story of Norton plants and warehouses
CHICAGO
PHILADELPHIA
CLEVELAND
PITTSBURGH
NORTON ABRASIVES
Over Half a Million Wheels in Five Branch Warehouses
Each of these branch warehouses is a vital nerve center in the Norton distribution system—a connecting link between customer, distributor and the Worcester plant. With their large stocks of grinding wheels and other abrasive products, their highly trained personnel, their special equipment for altering wheel sizes and shapes they bring real meaning to the words "Norton Service."
And supplementing these five strategically located Norton warehouses there are Norton distributors in 151 key cities of the United States alone with thousands of wheels on their shelves.
NORTON COMPANY
NORTON ABRASIVES
MAIN OFFICES AND PLANT AT
WORCESTER, MASS., U.S.A.

W-729

1370 Blount Street Cleveland, Ohio
SOLD BY THE WEAN ENGINEERING CO. INC. WARREN, OHIO

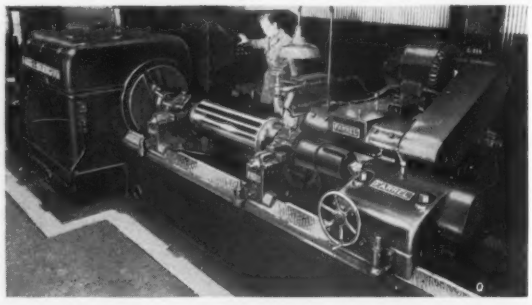


FARREL ROLLING MILLS are made for non-ferrous rods, strips or sheets and for cold strip steel. Built in a wide range of sizes, designed for any specific purpose to meet the demand for constantly increasing standards of quality at constantly decreasing cost of production.

FARREL CONSTANT TENSION REELS provide constant tension from empty to full reel, keep metal straight and flat, maintain uniform gauge. Various types to fit individual needs, all readily applied to your rolling mills.

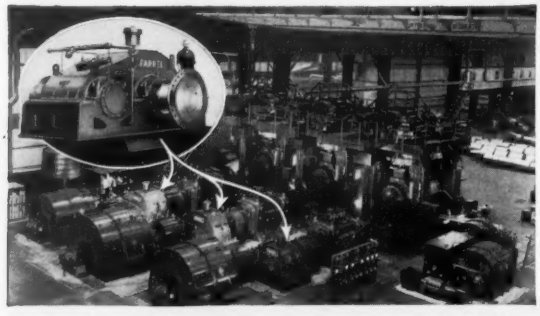
FARREL ROLLING MILL MACHINERY

ROLLING MILLS — For ferrous and non-ferrous metals. Complete rod mills from furnace to coilers.
ROLLS — Cupola and electric furnace chilled and alloy iron, heat treated Farrel Ni-Hard and steel.
ROD MILL TABLES AND MANIPULATING EQUIPMENT
UNIVERSAL MILL SPINDLES
ROD COILERS
LEAD PRESSES for PIPE or ROD
ROLL GRINDING MACHINES
ROLL CALIPERS
CINDER CRUSHERS
GEARS
MILL PINIONS
PINION STANDS
GEAR DRIVES
FLEXIBLE COUPLINGS

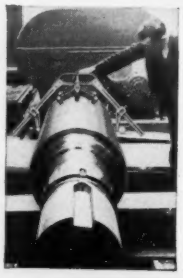


HEAVY DUTY ROLL GRINDERS—Specially designed for high output with high precision. Equally as efficient for heavy roughing or fine finishing on rolls of any material. Grinds perfect surfaces free of all marks, with concave, convex or straight contours of exact accuracy and symmetry. Six standard sizes for rolls in any length up to maximum diameters of 24", 28", 36", 44", 50" and 60".

NI-HARD ROLLS combine hardness of 80 to 90 scleroscope ("C" scale) with high strength and flawless surface. Ideal for high finish sheets, they produce a higher quality finish, have longer life and cut ton-cost of output.



FARREL GEAR DRIVES for rolling mill service are made in single, double and multiple reduction units, any ratio, any speed, any power. Designed to withstand the stresses, shocks and wear imposed by the heavy loads and high speeds encountered in the modern rolling mill.



ROLL CALIPERS are precision instruments designed for exact check of roll accuracy before removing from the grinder. Made in five sizes to measure rolls from 4" to 50" diameter.

FARREL REG. U.S. PAT. OFF.

FARREL-BIRMINGHAM COMPANY, Inc.
ANSONIA, CONN.
New York • Buffalo • Pittsburgh • Akron • Chicago • Los Angeles

Manufacturer's

WIRE

Continental specializes in the production of manufacturer's wire for a wide assortment of uses. The experience of our metallurgists is always at your disposal. Perhaps—as has happened with many manufacturers—they can point the way to faster work, fewer rejections, lower costs, and a better, more dependable product. As specialists in low-carbon wire we often can furnish a combination of analysis and temper that simplifies fabrication and improves strength in the final product.

Among the finishes offered by Continental are bright, bright and black annealed; sull-coated; processed; galvanized, including Flame - Sealed; liquored, coppered and tinned in many modifications. Eight shapes are standard, and many specials available. Regular gauges run from No. 34 to ⅝ inch. Furnished in coils of suitable sizes, or cut and straightened to specification.

CONTINENTAL STEEL CORPORATION

General Offices: Kokomo, Indiana • Plants at Canton, Kokomo, Indianapolis

CONTINENTAL

STEEL SHEETS AND WIRE PRODUCTS

Wire: Bright Basic, Annealed, *Kunik, Special Manufacturers, Galvanized, *Flame-Sealed

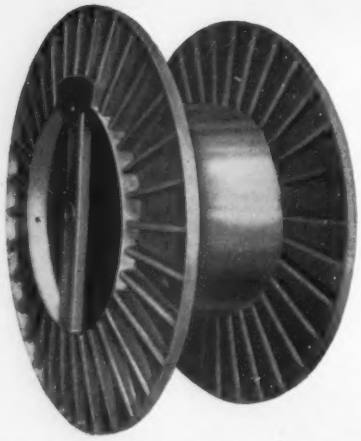
Wire Rods, Nails, Staples, Bale Ties, Barbed Wire; Fence 15 Types; Gates and Fittings

Sheets: Black, Galvanized, Special Coated; Roofing and Siding 14 Styles

*Trade Mark Registered, U. S. Patent Office

FOR REEL ECONOMY

STEVENS *LOW-TARE* STEEL SHIPPING REELS



MADE OF HIGH TENSILE STRENGTH STEELS
LOW WEIGHT PLUS LONG LIFE

FOR
ALL I. P. C. E. A. AND SPECIAL
SIZES AND CAPACITIES
36" TO 84" DIA. HEADS
INCLUSIVE

THE STEVENS FLANGED STEEL DRUM
Definitely Reduces Your Reel Assembly Costs.

Increases Life of Reel

Can Be Used to Equal Advantage With Either Wooden or Steel Heads.

Made in All I.P.C.E.A. and Special Sizes.

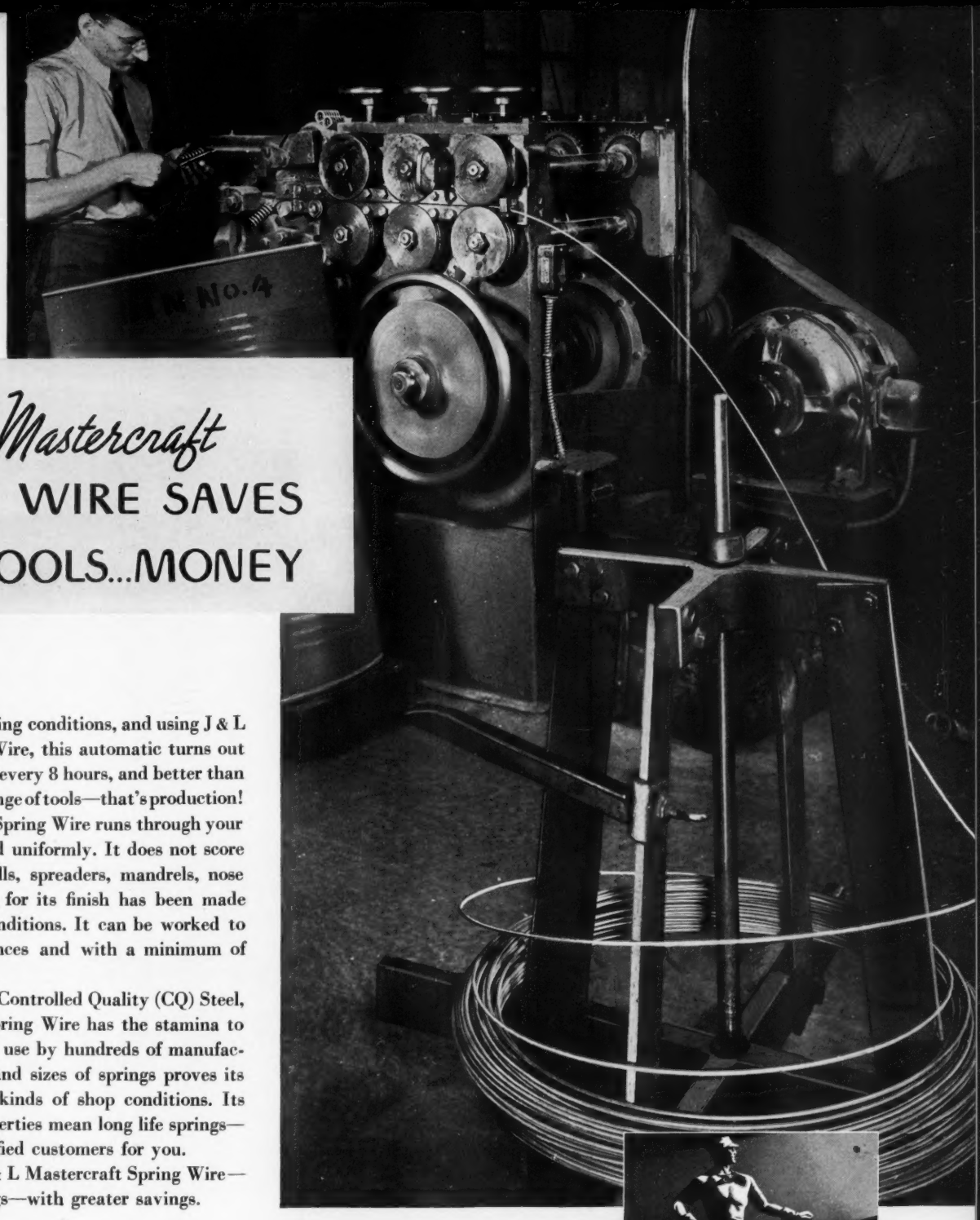
STEVENS FLANGED STEEL DRUMS

Made in Low Carbon Steel for Standard Weight and in High Carbon and Alloy Steels for Special Light Weight Drums.

Galvanized — Painted — Plain Finishes

Descriptive Matter and Prices Upon Request

THE STEVENS METAL PRODUCTS CO.
NILES, OHIO



J&L *Mastercraft* SPRING WIRE SAVES TIME...TOOLS...MONEY

Under routine operating conditions, and using J & L Mastercraft Spring Wire, this automatic turns out 12,000 clutch springs every 8 hours, and better than 300,000 without a change of tools—that's production!

J & L Mastercraft Spring Wire runs through your automatics easily and uniformly. It does not score your wire guides, rolls, spreaders, mandrels, nose pieces or other tools, for its finish has been made to suit your shop conditions. It can be worked to the closest of tolerances and with a minimum of machine adjustment.

Drawn from J & L Controlled Quality (CQ) Steel, J & L Mastercraft Spring Wire has the stamina to do a job for you. Its use by hundreds of manufacturers for all types and sizes of springs proves its reliability under all kinds of shop conditions. Its fatigue-resisting properties mean long life springs—and completely satisfied customers for you.

Specify and use J & L Mastercraft Spring Wire—and get better springs—with greater savings.

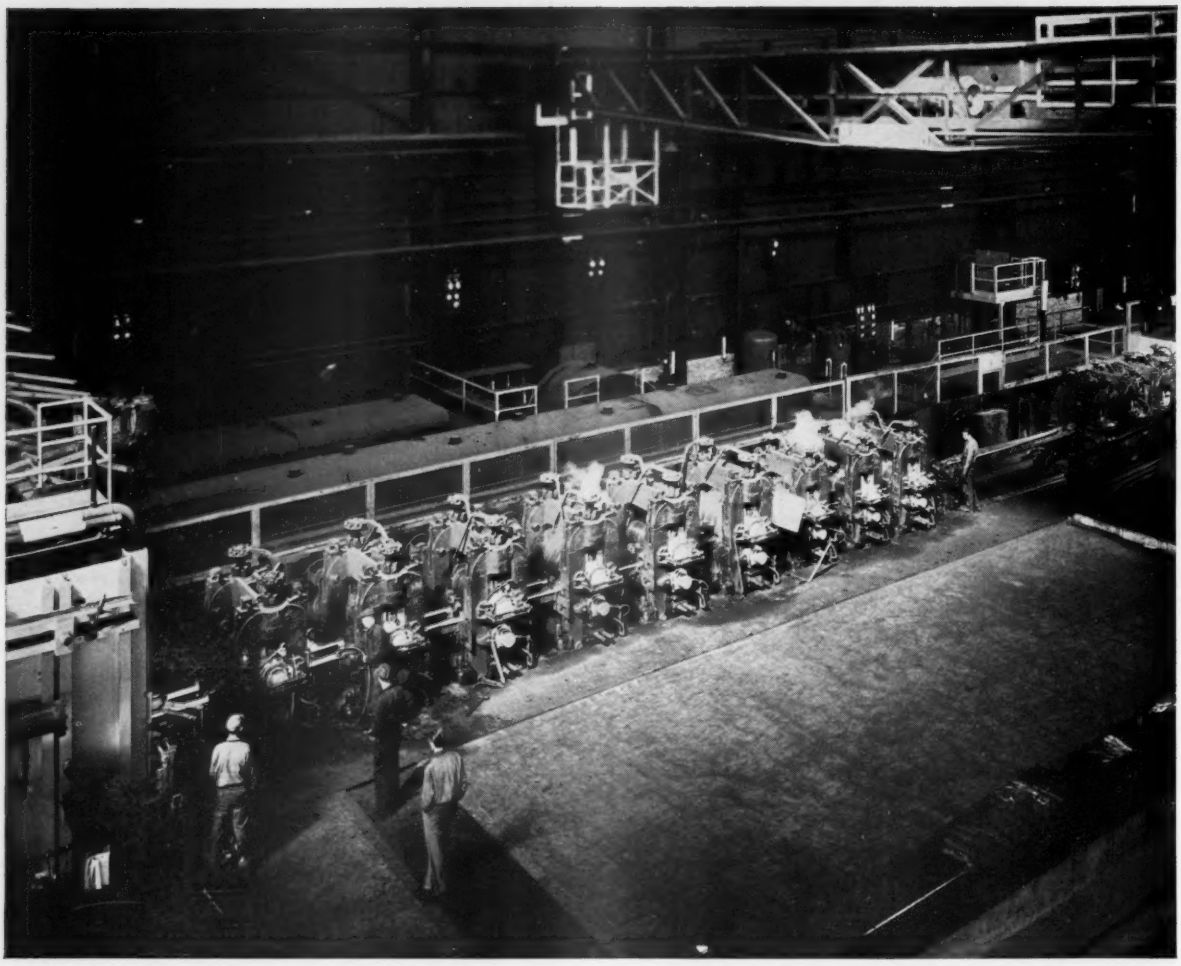
J & L—PILOTS THE COURSE OF CONTROLLED QUALITY IN STEEL

J&L STEEL

JONES & LAUGHLIN STEEL CORPORATION

AMERICAN IRON AND STEEL WORKS
PITTSBURGH, PENNSYLVANIA

J & L—PARTNER IN PROGRESS TO AMERICAN INDUSTRY



How Bethlehem's new 8-motored mill improves rod quality

A rod-mill contains many power-driven "roll stands," which receive the hot billet from the furnace and change it by successive reductions into a finished rod. Speed of the rolls must increase at each "stand" as the rod is reduced and elongated. Close speed synchronization between "stands" is necessary to prevent stretching, straining or overfilling as the rods pass through the mill.

Bethlehem achieves this synchronization by using *eight separate motors to control the speed of rolls instead of using a single motor and fixed gear trains.*

Result: Bethlehem's rods are "hair-trigger" controlled. They are uniform in size and quality —the kind that mean real money to rod processors who are looking for production savings.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

PRODUCTION-TESTED AND APPROVED!

AETNA WIRE DRAWING MACHINES

PATENTS PENDING

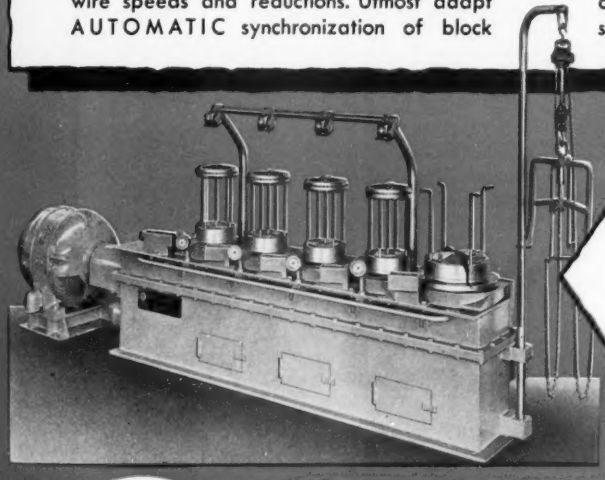
FOR SPEEDY AND ECONOMICAL MANUFACTURE OF WIRE
WITH PRECISION AND WITH UNIFORMLY HIGHER FINISHED QUALITY

THE AETNA SINGLE UNIT WIRE DRAWING MACHINE

Powered by individual vertical motor. Water-cooled block and die. Three nominal UNIT sizes—12″, 16″ and 22″. Block diameters—12″ to 26″. Two or more UNITS can be arranged for both single and tandem drafting.

THE AETNA MULTI-UNIT WIRE DRAWING MACHINE

Combinations of two or more UNITS arranged in tandem. Each UNIT powered by vertical adjustable speed motor. Water-cooled blocks and dies. UNIT sizes—12″, 16″ and 22″. Maximum range of wire speeds and reductions. Utmost adaptability. Fully AUTOMATIC synchronization of block speeds.



THE AETNA GROUP DRIVEN MULTI-DRAFT WIRE MACHINE

Consisting of a series of drawing blocks geared in tandem to a single motor. Water-cooled blocks and dies. Block diameters: Intermediate 8″ & 12″; Finishing 8″, 12″ & 16″.

THE AETNA WIRE POINTER

Comprising two grooved rolls and a shear. Powered by a standard constant speed A.C. Motor. Safety foot switch normally "off." Produces smoothly tapered points quickly.

AETNA-STANDARD ENGINEERING COMPANY

CONSULTANTS—DESIGNERS AND BUILDERS TO THE STEEL AND NON-FERROUS INDUSTRIES

YOUNGSTOWN, • OHIO, • U. S. A.

ASSOCIATED COMPANIES

Head, Wrightson & Co. Limited, Thornaby-on-Tees, England. Aktiebolaget Arboga Mekaniska Verkstad, Arboga, Sweden.

SIGNS OF THE TIMES!

Cleveland Wire Mills Book Large Volume Of Rush-Delivery Orders

CLEVELAND, Sept. 25.—A flood of orders is being received by makers of steel wire and wire products here. Production schedules are being stepped up sharply. Buyers are asking prompt delivery and producers are making intensive efforts to comply. Automotive demand has been outstanding. Many diversified users of wire products are joining in the scramble for a place on the books.

Bolts, Nut and Rivet Makers Enjoying Best Business In Over 2 Years

CLEVELAND, Sept. 25.—Cleveland makers of bolts, nuts and rivets are speeding up production following receipt of heavy orders from the automotive industry and other consuming lines. Bookings this month, it is estimated, will be the largest for any month in more than two years. Automotive demand is especially good.

The Wire Industry

▲▲▲ AND ▲▲▲

The Wire Products Industry

ARE BOTH

- Busy and Prosperous -

▲▲ NEW AND ADDITIONAL ▲▲

MACHINERY — SUPPLIES — EQUIPMENT

WILL BE IN ALMOST

—— IMMEDIATE DEMAND ——

▲▲▲ WHY NOT ▲▲▲

— Get Your Share of the Business —

▲▲▲

YOU WILL IF YOU

Advertise NOW in WIRE AND WIRE PRODUCTS

Tell Your Sales Story to Practically Every Purchasing and Production Executive in the Industry — The Men Who Do the Buying — Tell Them NOW and Get the BUSINESS — For They All Read the Magazine.

For Detailed Information —
Advertising Rates — Etc., Address

RICHARD E. BROWN,
ADVERTISING MANAGER,
WIRE & WIRE PRODUCTS

300 MAIN ST. | TELEPHONE STAMFORD 3-0482 | STAMFORD, CONN.

Look for our display advertisement in the November Issue of Wire and Wire Products showing complete details of the new installation in the largest steel company in Canada.

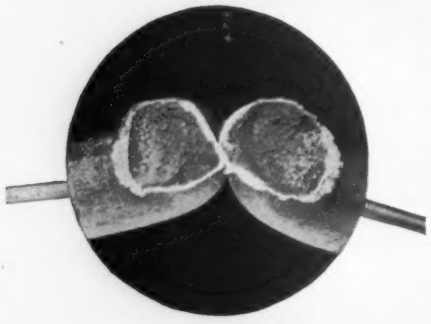
It will "show you something"
in ROD BAKING
CARL-MAYER
"Hi-Speed" Rod Baker
Patents Allowed and Patents Pending
It is backed by 20 years' experience and a reputation for advanced engineering and dependability in industrial oven construction . . . Write for literature today.
Side and end section views of High Speed Rod Baker.
Direct or Indirect Heat
Gas or Oil
THE CARL-MAYER CORP.
ROD BAKERS ~ OVENS ~ AIR DRAW FURNACES
3030 EUCLID AVENUE ◇ CLEVELAND, OHIO

NOT "IF" . . . BUT "WHEN"

To most of the wire mill operators who are galvanizing wire under the old methods, adoption of an improved process is no longer a question of "If" — but of "When."

Data on Meaker Process based on four years' commercial operation is now available to wire manufacturers who are actively planning to meet the ever-growing demand for superior zinc coatings.

MEAKER PROCESS for ELECTRO-GALVANIZING ROUND WIRE



Extreme ductility and adhesion of Meaker process zinc coating illustrated above. Photograph of No. 12 wire shows steel completely severed by bending. Pieces held together by portion of zinc coating which acts as hinge when pieces are bent back and forth. (Zinc 2.4 oz. per sq. ft.)

FULL FLEXIBILITY OF CONTROL. Various gauges of wire can be electro-galvanized simultaneously in the same unit, with full control of coating weights on strands or groups of strands.

HIGH OR LOW CARBON STEEL. Meaker Process handles high or low carbon steel with equal success, without impairment of physical qualities of the wire.

APPEARANCE. Meaker Process imparts a smooth, attractive, saleable finish that retains its lustre. No mechanical burnishing required.

FULL RANGE OF COATING THICKNESS. The heaviest obtainable by any process — or the lightest, with uniform distribution at any weight.

DENSITY. Operation at high current densities produces extremely dense, non-porous coatings.

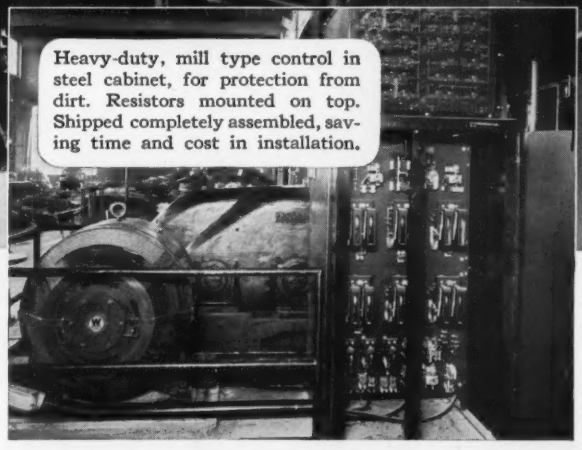
ADHESION. Meaker coatings withstand severest forming operations without cracking or peeling.

COST OF PRODUCTION. Ask us for up-to-date figures—they may surprise you.

THE MEAKER CO.
CHICAGO

inch by inch . . . then full speed ahead!

Notice speed adjusting rheostat at right — calibrated in motor rpm and feet per minute — permitting operator to set machine for any desired wire drawing speed.



Heavy-duty, mill type control in steel cabinet, for protection from dirt. Resistors mounted on top. Shipped completely assembled, saving time and cost in installation.

CO-OPERATION BETWEEN MACHINERY BUILDER AND WESTINGHOUSE PRODUCES WIRE DRAWING MACHINE WITH GREAT SPEED FLEXIBILITY

This Morgan No. 105 horizontal bull block is intended primarily for drawing large sizes in steel alloy and other materials. Driven by a special Westinghouse d-c motor of wide speed range, it is controlled by a rheostat calibrated both in motor rpm and in feet per minute.

The control gives an inching speed of less than $^1/_{12}$ of maximum speed, which allows the operator to take up slack with a minimum amount of shock — and then to run his machine at full speed ahead.

The machine is an outstanding example of improvement in design — accomplished by complete co-operation between the machine builder and Westinghouse. Our engineers are at your service in similar or other electrical problems. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

J-94091

Westinghouse

ELECTRICAL PARTNER OF THE STEEL INDUSTRY

BELL-MINE

Rotary Kiln

PULVERIZED LIME

For Wire Drawing

At the Congress Hotel, headquarters for the 1939 meeting and exhibition of the Wire Association, October 23-26, consult our Mr. R. L. Hamaker for information or quotation.

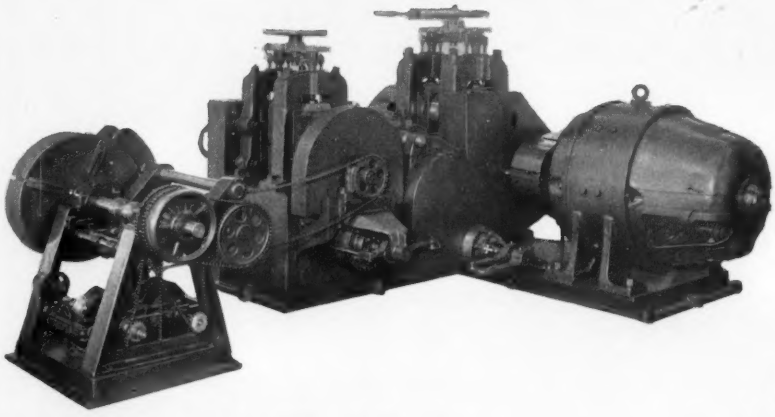
WARNER COMPANY

BELLEFONTE DIVISION

Philadelphia, Pa. Bellefonte, Pa. New York, N. Y.

MANUFACTURER OF ***BELL-MINE*** LIME PRODUCTS

Machinery For The Wire Industry!



No. 383 Tandem Flat Wire Rolling Mill. ✦ ✦ ✦ ✦ ✦

ROLLS

10x6 Breakdown
With Timken Bearings. ✦ ✦

5¾x2 Edging Rolls—
Precision Roller. ✦ ✦ ✦

8x5 Finishing Rolls
With Timken Bearings. ✦ ✦

3 to 1 Adj. Speed D.C. Motor

— also with —

#319 Take-Up — Adjustable While Running for Wire Spacing and Width of Travel.

Dow Metal Collapsible Blocks in Several Sizes for Coil Winding. ✦ ✦

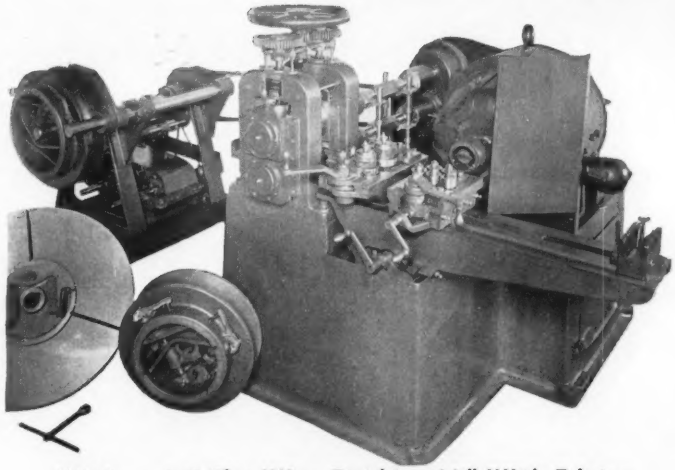
#319 Mill Has
All Rolls Mounted on Precision Roller Bearings. ✦ ✦ ✦ ✦ ✦ ✦

3 to 1 Adj. Speed D.C. Drive

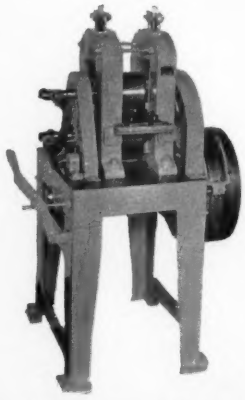
— with —

Take-Up Adjustable While Running for Wire Spacing and Width of Travel. ✦

Dow Metal Collapsible Blocks. ✦ ✦



#319 — 6x5 Flat Wire Finishing Mill With Edging and Straightening Rolls, also Tension Block. ✦ ✦



#326 Single Stand Mill. ✦ ✦

6"x4" Rolls Mounted in Bronze Bearings or Precision Roller Bearings. Belt or Motor Driven. ✦ ✦ ✦ ✦ ✦

Also — Rod Coilers — Double End Billet Turning Lathes — Heavy Rod Pointers — Inverted Rod Drawing Blocks —

✦ ✦ Complete Multiple Strand Annealing Equipment for Fine Wires —

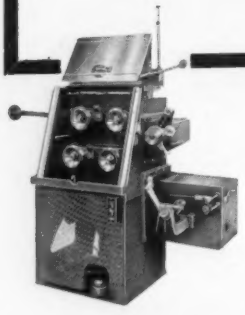
✦ ✦ Multiple Strand Handling Equipment For Medium and Heavy Wires —

FREDERICK M. CONRAN

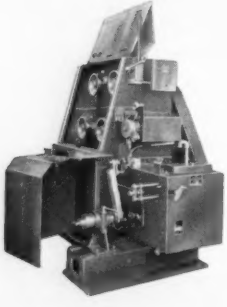
Designer of Special Machinery for Rod, Wire, Tube, Strip and Cable.

107 Colden St. Newark, N. J.

Why . . . . . .
Syncro equipment insures . . .
quality products at low cost.

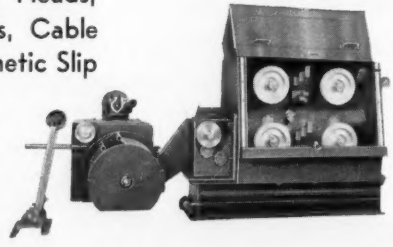


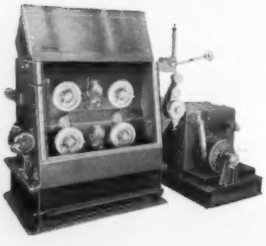
Because Syncro machines are designed by men who are familiar with your problems — and because they are precision built in accordance with the best modern practice — they produce uniformly high quality products at the lowest possible operating and maintenance costs.



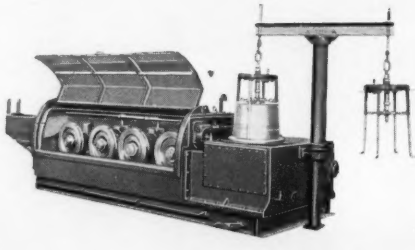
Whether you are interested in Wire Drawing Machinery, Insulating Machinery, Taping Heads, Capstans, Annealing and Tinning units, Cable Take-Ups employing the new Syncro Magnetic Slip Clutch or allied machinery, we believe that you will get the most for your money in the modern Syncro line.

May we quote on your requirements?





SYNCRO



SYNCRO · MACHINE · COMPANY

420 Lexington Avenue New York

Represented in Canada by — Canadian Elevator Equipment Company, Ltd., Toronto

HUDCO

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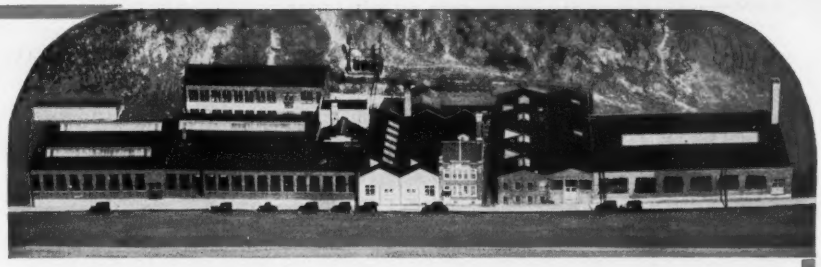

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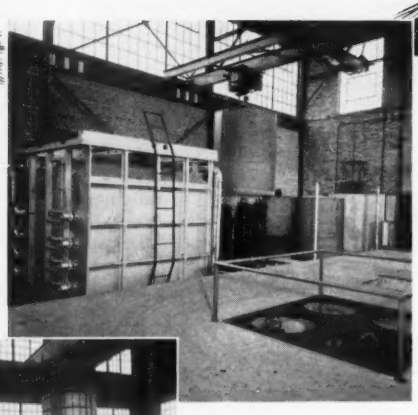

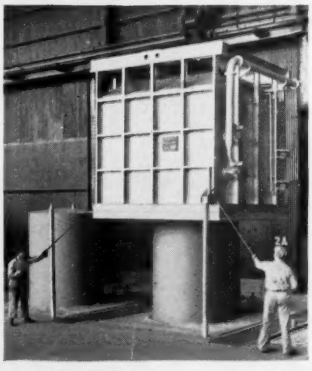

Shown are four recent installations of SC Radiant Tube Bell-Type Covers for spheroidizing, annealing, and normalizing wire. Covers are in operation treating single, to as many as four stacks of coils at the same time.

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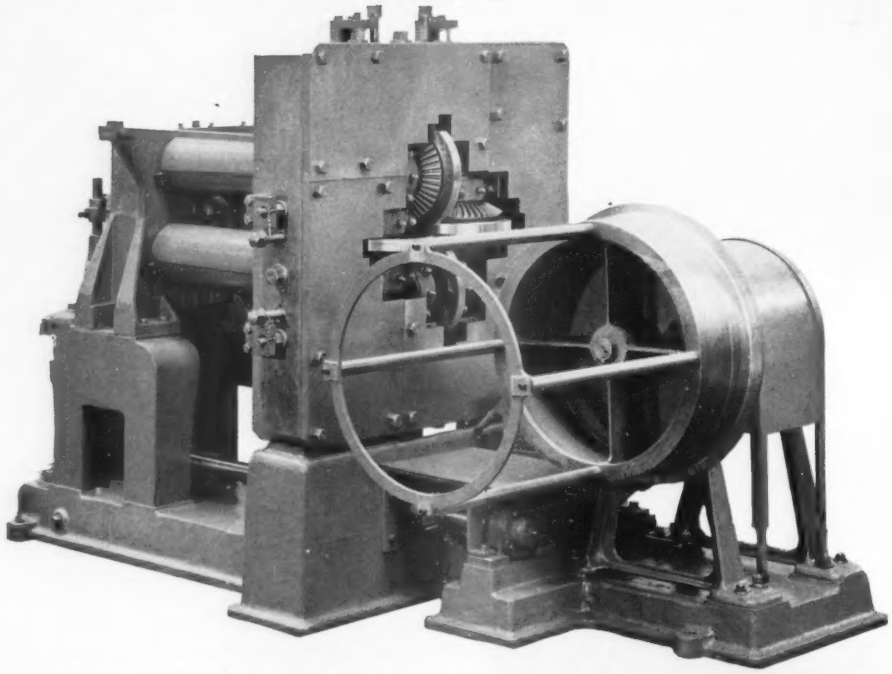

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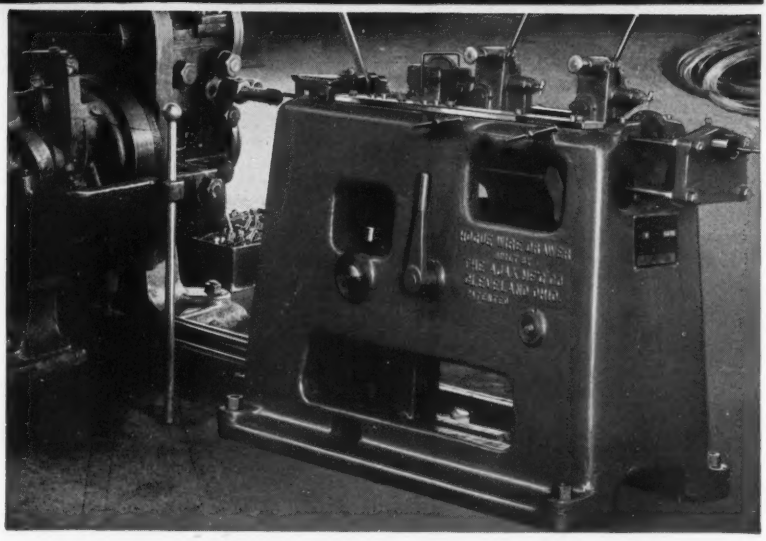

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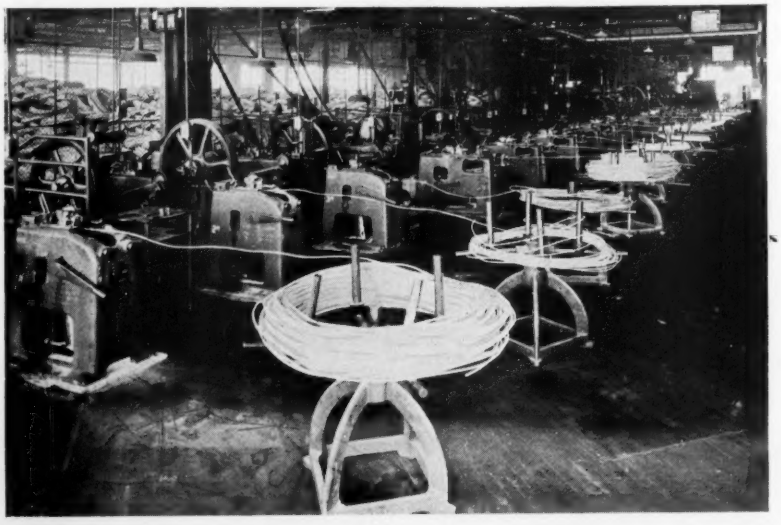
If you operate cold headers you should not fail to investigate the Ajax-Hogue Wire Drawer. Without obligation write for Ajax Bulletin No. 111.



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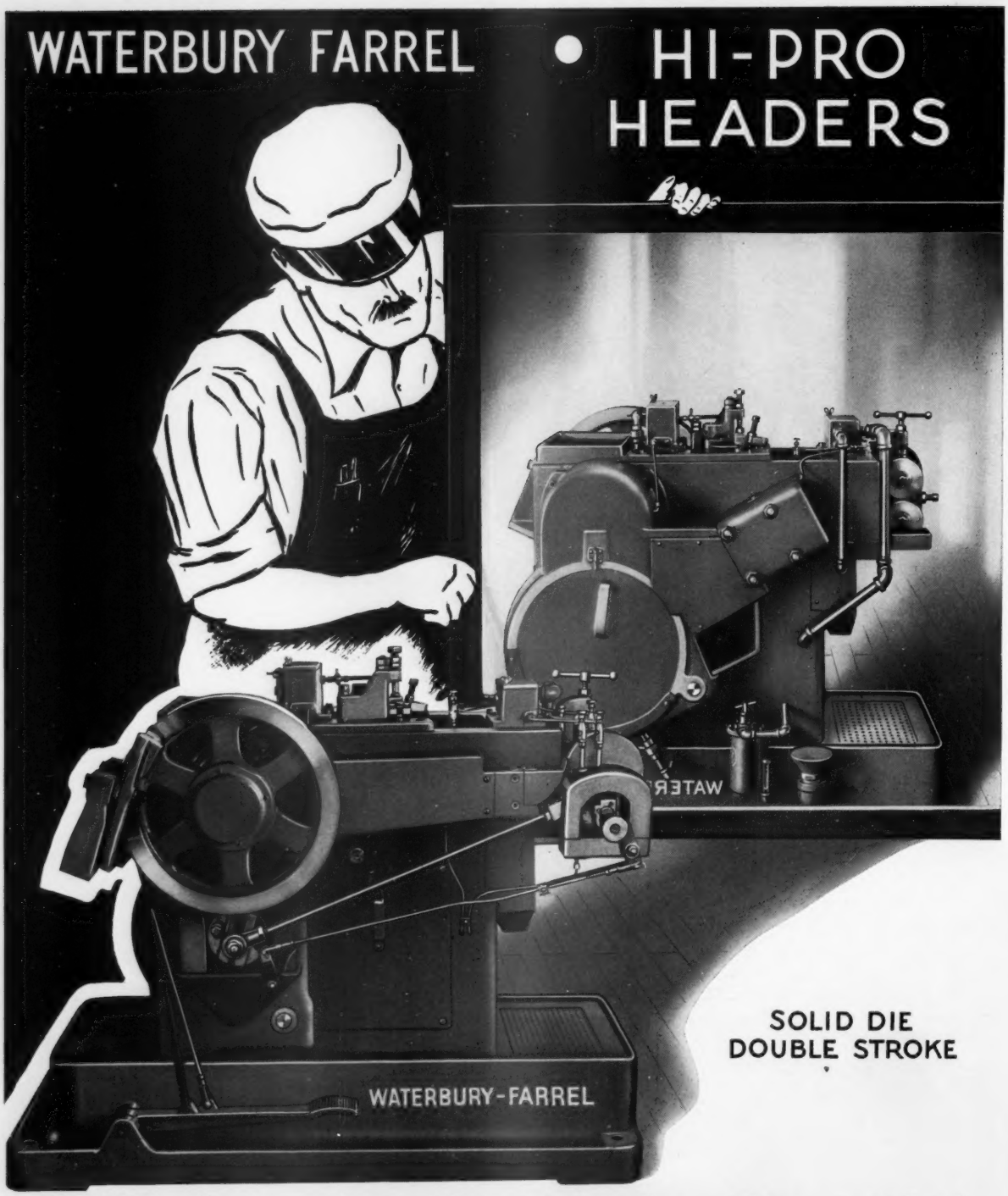

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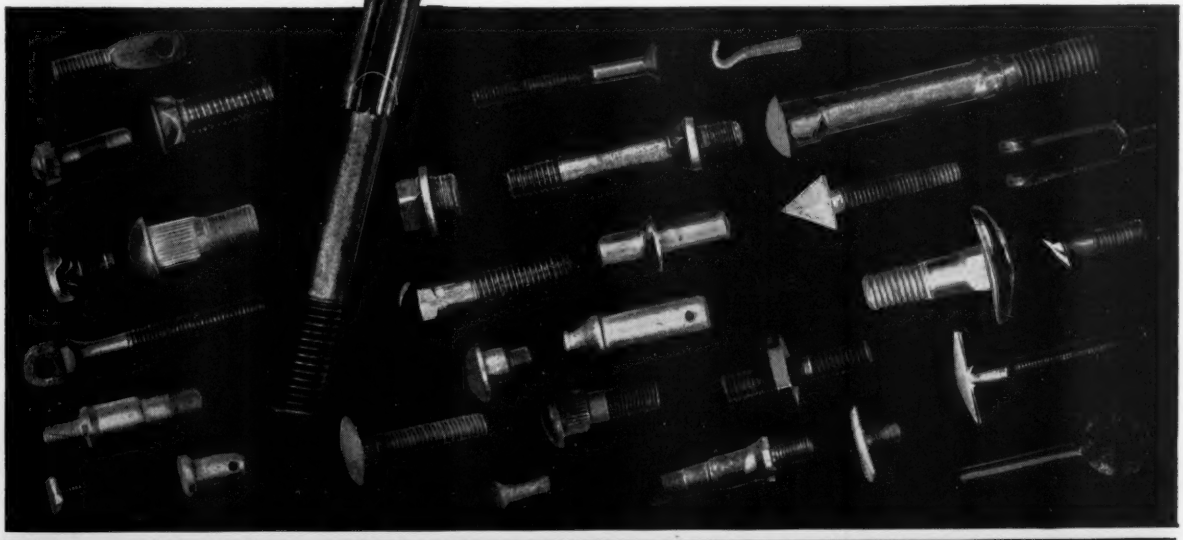

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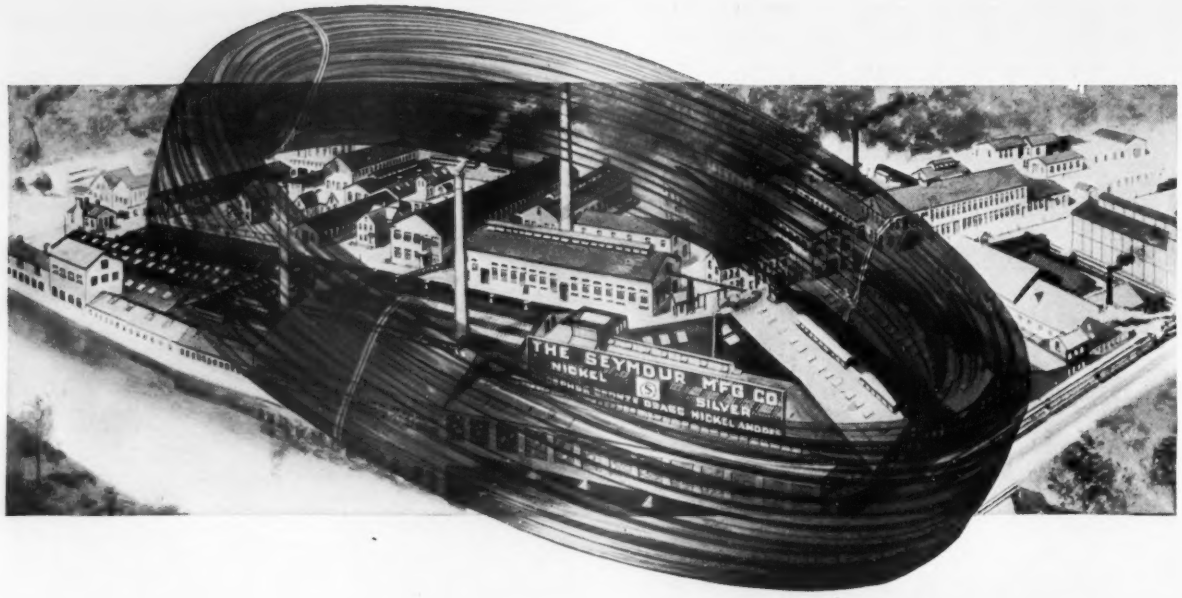

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To our old friends who have been dealing with us regularly over the years, this is not news; but thousands of new people come into positions of importance in industry each year, and it is to these that this more or less historical advertisement is directed.

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WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. 14 OCTOBER, 1939 No. 10

Designated as

Official Publication By The Wire Association

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Publication Office: Washington, N. J.
Executive Office: Stamford Trust Co. Bldg., 300 Main St., Stamford, Conn.
Annual Subscription, U. S. $5.00, Canada $5.00

50 Cents a Copy Issued Monthly Foreign, $7.50

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WIRE & WIRE PRODUCTS, Vol. 14, No. 10, October, 1939, Executive Office, 300 Main St., Stamford, Conn. Published by the Quinn-Brown Publishing Corp., Richard E. Brown, President; R. S. Spengel, Secretary and Treasurer. Publication office, 13 West Church Street, Washington, N. J. Subscription price: U. S., $5.00; Canada, $5.00 per year, 50 cents per copy; Foreign, $7.50 per year. Entered as second class mail at the Post Office, Washington, N. J., under Act of March, 1879.

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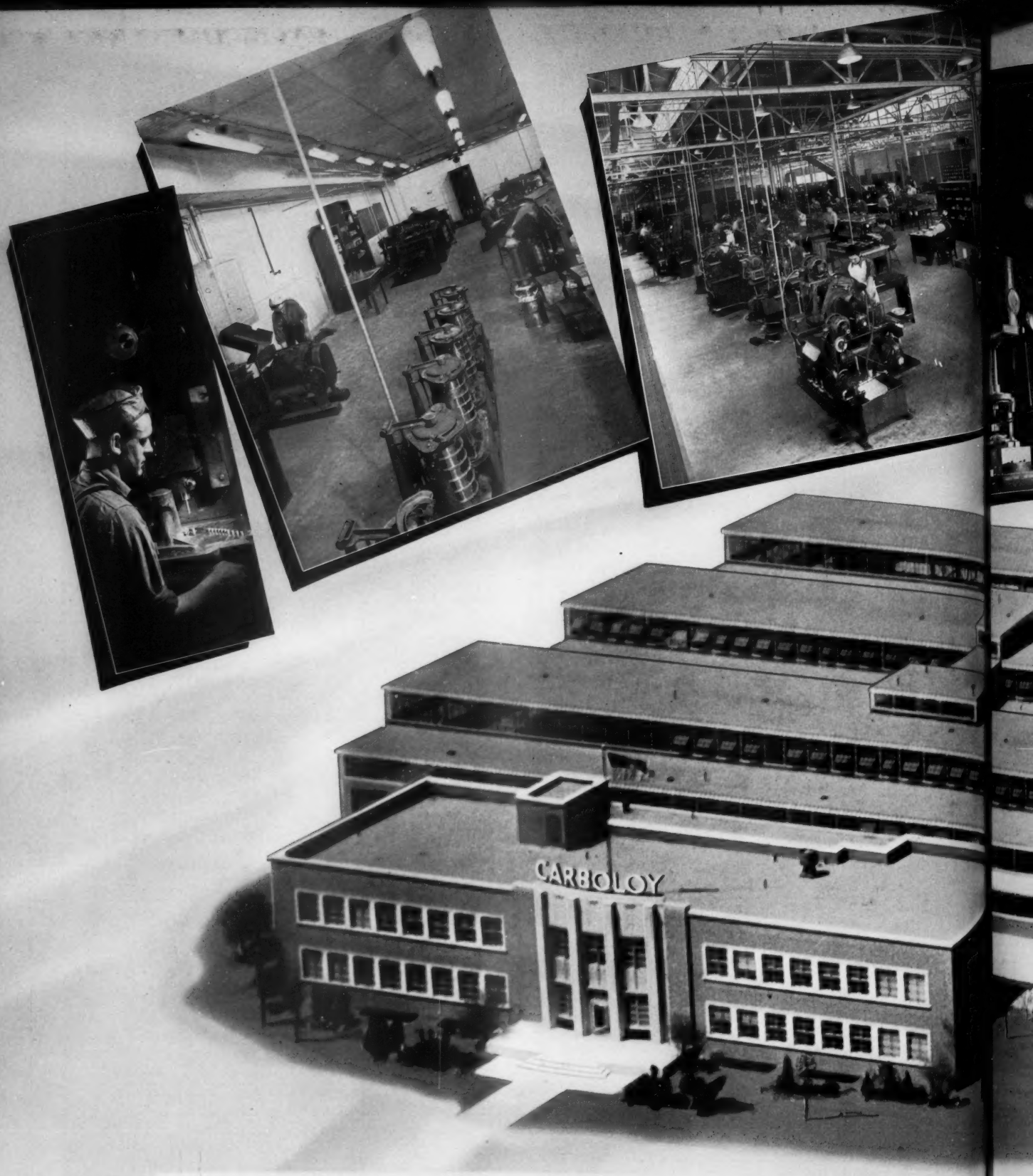
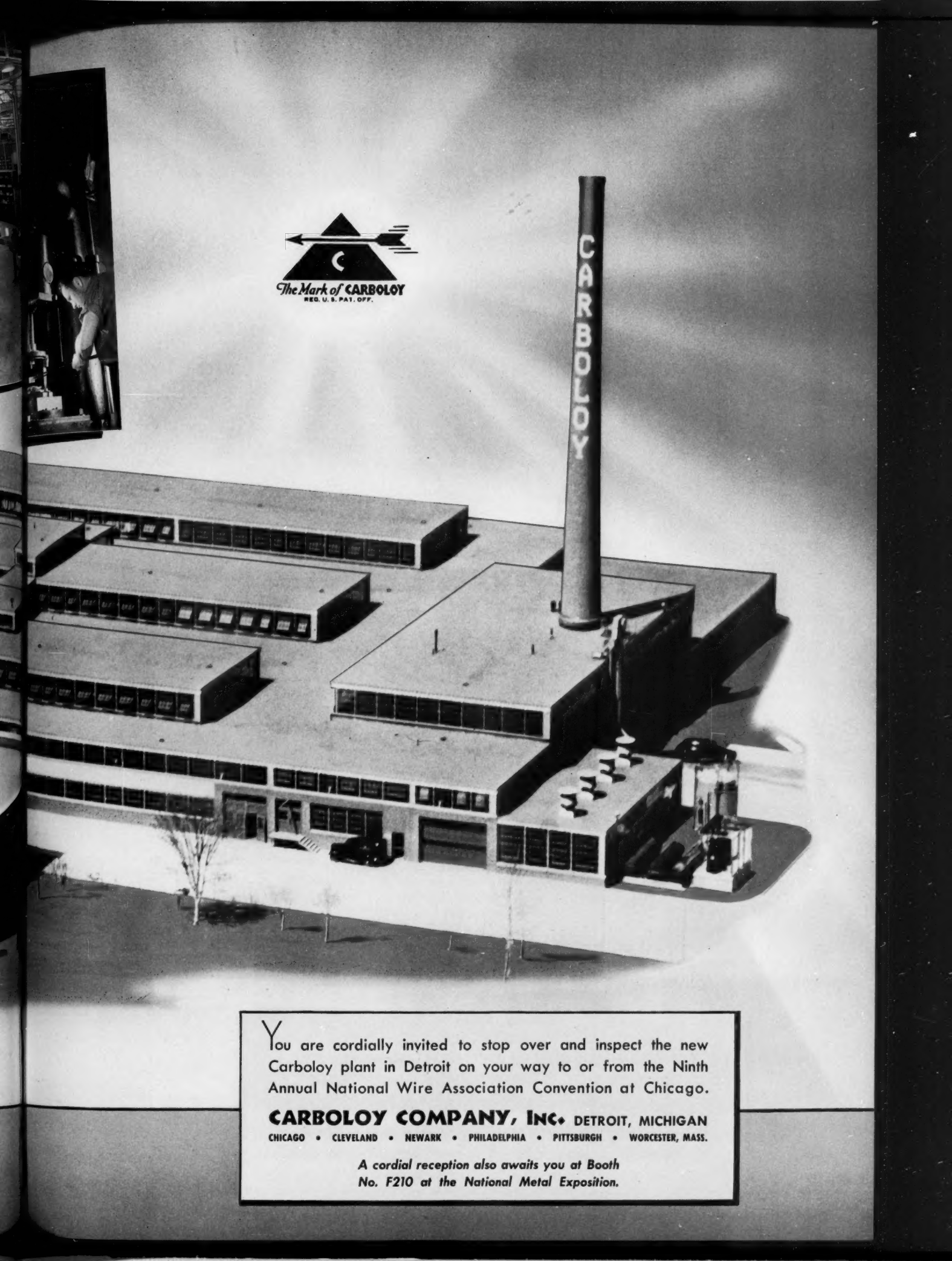


An Invitation

to visit the new Carboloy plant at Detroit — largest cemented carbide manufacturing facilities in the United States.



You are cordially invited to stop over and inspect the new Carboloy plant in Detroit on your way to or from the Ninth Annual National Wire Association Convention at Chicago.

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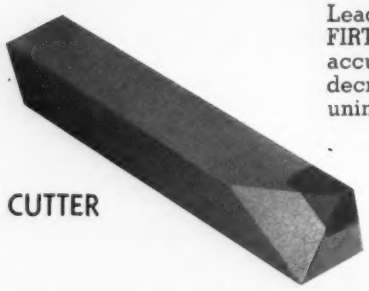

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GUIDE

ONE USER REPORTS:

A FIRTHALOY Arbor is cutting music wire size .168" for springs having an inside diameter of 7/16". The production with the FIRTHALOY Arbor to date is 700,000 springs, and the Arbor is still in service.

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A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.

DRAWING --- ROLLING --- EXTRUDING --- FORMING --- FABRICATING

Vol. 14 OCTOBER, 1939 No. 10

Manufacture and Use of Stainless Steel Wire

By Stanley P. Watkins,

Manager, Sales Development,
Rustless Iron & Steel Corporation, Baltimore, Maryland

As an introduction, the characteristics of the various grades of stainless steels most commonly used in wire form are discussed in general, with tables giving physical and tensile properties. Also, some attention is given to their working properties, such as forming, welding and cold heading. ✦ ✦ ✦ ✦ ✦

In the section devoted to the manufacture of stainless steel wire, the various steps from melting to final cold drawing is discussed in considerable detail. Charts are given which illustrate the effect of cold reduction on the tensile properties of the various grades. ✦ ✦ ✦ ✦

Following manufacturing, many typical applications of stainless steel wire are discussed, with particular reference to wire requirements and methods of processing and finishing of fabricated articles. ✦ ✦ ✦

THE increasing demand for corrosion and heat resisting stainless steels in fabricated wire products ranging from tiny screws and nails to wire fence and finely woven screens, has stimulated the use of stainless steel wire in many industries. Wherever resistance to corrosion and heat is a factor in the life of metal parts, stainless steel is finding an ever increasing field in the lengthening of their useful service life. The extent of the burden placed upon industry by deterioration of equipment from corrosion and heat is not generally realized but it amounts to millions of dollars yearly. The prime causes of corrosion are the atmosphere and the elements which are common to all industries. In addition, certain industries such as meat packing, dairy and food processing, chemical, textile and paper, have corrosive conditions which involve not only disintegration of equipment but contamination of their products as well. The stainless steels have solved many of industries' toughest corrosion problems and although not a panacea for all such evils, they are the lowest cost materials available having a wide range of resistance to industrial conditions.

✦ ✦ ✦

IN addition to being highly resistant to oxidation and corrosion, they have other excellent physical and fabricating qualities; including toughness, ductility and over twice the strength of ordinary steel. In short, they offer more permanence to products, while at the same time permit the use of sections having the same strength but lighter in weight.

✦ ✦ ✦

STAINLESS steel is a generic name and does not identify one material alone, but embraces a present group of over 60 different analyses, each with its own specific characteristics.

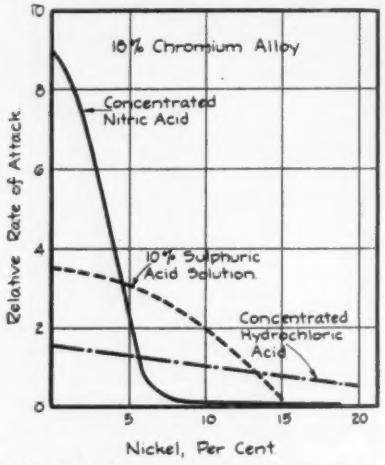
✦ ✦ ✦

OUT of the many possible elements which might be alloyed with iron or steel, chromium is the only one yet found that has the unique property of conferring upon them, at a reasonable cost, remarkable resistance to corrosion and oxidation. It fortifies the entire body of metal against attack by destructive agents. The amount of chromium required to produce true stainless characteristics is determined largely by the analysis of the iron or steel to which it is

added—especially with respect to their carbon contents. Theoretically, approximately upwards of 10% of chromium will produce definite stainless properties in pure iron. For maximum resistance with minimum chromium, a low carbon content is desired; but where the nature of the application demands greater hardenability, a high carbon content is essential. Gradual increases in chromium produce progressive, though not proportional, increases in corrosion and heat resistance.

✦ ✦ ✦

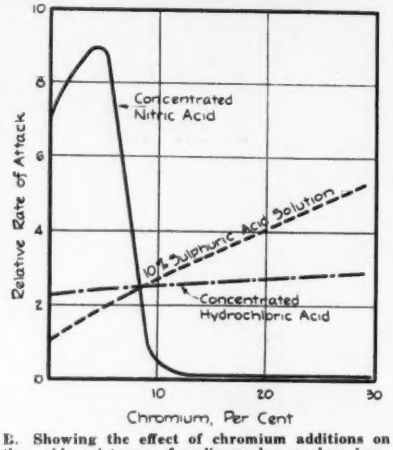
IN combination with chromium, other elements may be alloyed with iron to obtain special characteristics. The most important of these elements is nickel. When both nickel and chromium are added in correct proportions, the resulting alloy, of which the well known 18-8 is a type, is extremely ductile, highly resistant to corrosion and particularly well adapted for forming and welding operations. Other elements are added to impart special characteristics. Molybdenum increases corrosion resistance and silicon protects against scaling and oxidation at high temperatures. Sulphur and selenium, in amounts above approximately .15%, impart free-cutting and non-seizing characteristics. Tungsten additions increase strength at high temperatures and titanium and columbium are helpful in preventing carbide precipitation in the 18-8 alloys, thus reducing their susceptibility to intergranular corrosion. In addition, carbide precipitation in the 18-8 stainless steels can be effectively controlled by lowering the carbon content to below .07%.



A. Showing the effect of nickel additions on the acid resistance of 18% chromium stainless steel.

STANLEY P. WATKINS
Manager, Sales Development
Rustless Iron and Steel Corporation,
Baltimore, Md.

Born in Russellville, Alabama, in 1904, educated in Alabama public schools, Birmingham-Souther College and Carnegie Institute of Technology; Associate Metallurgist at U. S. Naval Laboratory, Munhall, Pennsylvania, 1927 to 1929; Metallurgist Wrought Iron Research Association, Pittsburgh, Pennsylvania, 1930 to 1931; 1931 to present time, Rustless Iron and Steel Corporation, Baltimore Maryland, Metallurgist, Sales Engineer and Manager Sales Development. Member The Wire Association.



B. Showing the effect of chromium additions on the acid resistance of ordinary low carbon iron.

VARIATION of the combination and proportion of the alloying elements results in the production of three distinct types of stainless steels.

Group I. Straight Chromium Stainless Steels—Hardenable.

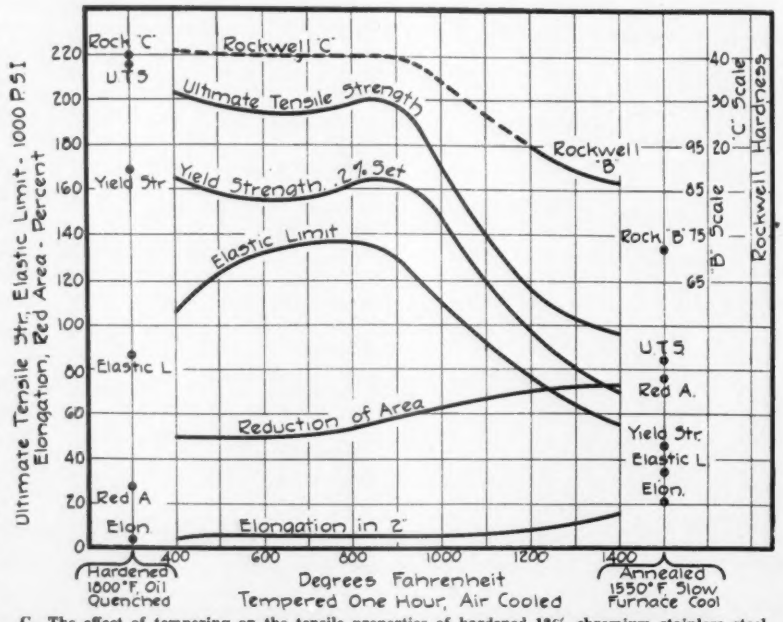
Group II. Straight Chromium Stainless Steels—Non-Hardenable.

Group III. Chromium — Nickel Stainless Steels.

✦ ✦ ✦

Group I—Straight Chromium Stainless Steels—Hardenable

THE low carbon alloys of this group have excellent corrosion resisting properties in all conditions of heat treatment. Their adaptability is suggested by their use in appli-



C. The effect of tempering on the tensile properties of hardened 12% chromium stainless steel wire.

✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

cations involving exposure to process solutions of neutral salts, basic salts, natural food acids, waste products and iron bearing mine waters. The higher carbon alloys require to be fully hardened to develop maximum corrosion resistance. Metallurgically, the alloys in this group are martensitic, magnetic and capable of being heat treated to obtain a hardness in excess of Rockwell "C" 58. Although these stainless steels possess relatively low work-hardening susceptibility, their tensile strength and hardness can be increased by cold working. However, tensile properties can be improved much more easily by heat treatment.

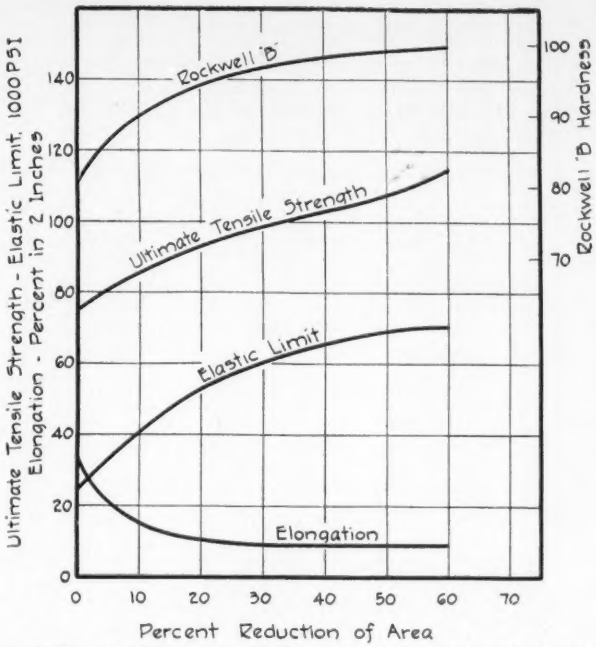
✦ ✦ ✦

IN the annealed condition, alloys of this group have good ductility and in the form of wire may be readily cold upset, swaged and woven into screens. The only exception is the 12% chromium free-cutting alloy, which contains a high sulphur content and, consequently, is less suitable for cold upsetting and swaging. In the heat treated condition, they possess high hardness and tensile strength which renders them particularly suitable for applications such as metal drive screws, springs and auto aerial parts. Due to the tendency of these stainless steels to air harden in welding, they are not as satisfactory as the 18-8 alloys for making fabricated articles such as wire shelves and baskets, which usually involve resistance welding.

✦ ✦ ✦

Group II—Straight Chromium Stainless Steels —Non-Hardenable

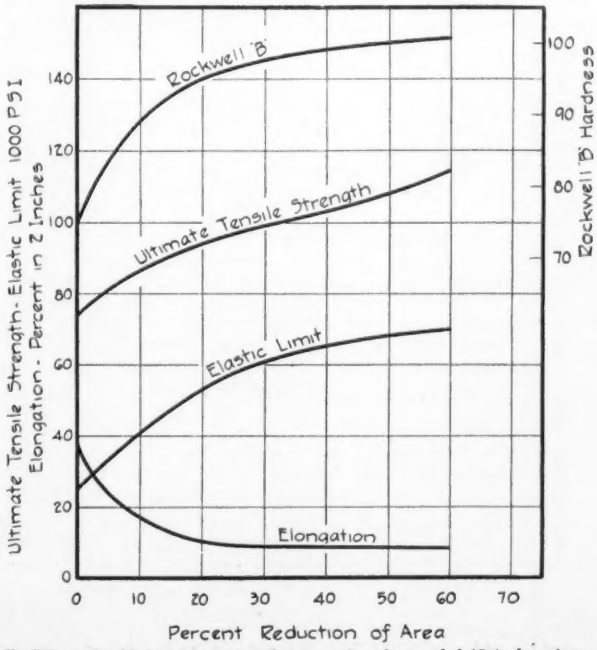
THE higher chromium content of the alloys in this group make them considerably more corrosion resisting than Group I stainless steels. They are highly resistant to atmospheric conditions and will remain untarnished on exposure, provided the surfaces are clean and bright. The 18% chromium grade is noteworthy for its excellent resistance to nitric acid, which has led to its wide utilization in the chemical industry. The 27% chromium grade is highly resistant to oxidation and does not scale appreciably until heated above 2000° F. This property makes it especially useful for heat resisting applications. Metallurgically, these alloys are ferritic; magnetic and cannot be hardened by heat treatment, but it is possible to raise their hardness and tensile strength to some extent by cold working.



D. Effect of cold drawing on tensile properties of annealed 12% chromium stainless steel wire.

✦ ✦ ✦

THESE stainless steels possess excellent ductility in the annealed condition, and with the exception of the 18% chromium free-cutting grade, are applicable to severe cold upsetting, swaging and forming operations. The 18% chromium grade is particularly suitable for cold upsetting operations such as making screws, and a large tonnage is used for this purpose. Also, it is adaptable for fabricated articles by resistance welding, but careful technique is required to obtain strong and ductile welds. The use of this grade in the form of wire has increased materially during the past few years, due largely to its utilization in the form of screens by the automotive and allied industries. The 27% chromium stainless steel has not been used to any great extent in the form of wire, although some recent developments indicate this alloy to be an ideal material for lead-in wires on a newly developed radio tube.



E. Effect of cold drawing on tensile properties of annealed 17% chromium stainless steel wire.

✦ ✦ ✦

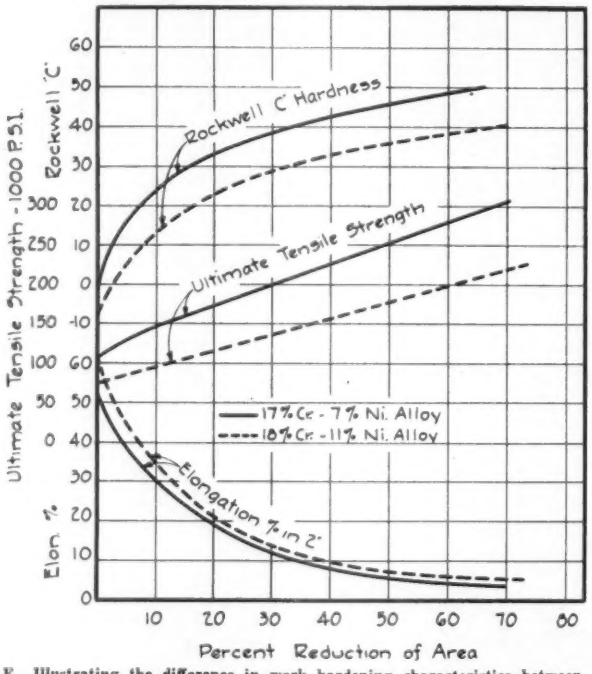
Group III—Chromium-Nickel Stainless Steels

TYPICAL of this group is the well known "18-8" stainless steel consisting of 18% chromium

STRAIGHT CHROMIUM STAINLESS STEELS—HARDENABLE

Stainless Steel Type No.	410	414	416	420	440
Carbon	.15 Max.	.15 Max.	.15 Max.	.40 Max.	.90-1.00
Chromium	10.00-14.00	12.00-14.00	12.00-14.00	12.00-14.00	14.00-18.00
Nickel	.50 Max.	2.00 Max.	.50 Max.	.50 Max.	.50 Max.
Sulphur			.15 Min.		
Ultimate Tensile Strength—1000 P.S.I.	75-190	100-225	75-185	85-250	105-285
Yield Strength	40-175	75-175	40-170	40-220	60-275
Elongation % 2"	35-10	25-10	32-10	34-3	21-115
Rockwell Hardness	"B" 75-"C" 42	"B" 90-"C" 45	"B" 75-"C" 40	"B" 75-"C" 55	"B" 90-"C" 60
Specific Gravity	7.77	7.80	7.77	7.77	7.72
Electrical Resistance, Microhms/CM³	57.0	61.0	57.0	60.0	60.0
Thermal Conductivity, C.G.S. Units at 100°C.	.060	.057	.060	.058	.058
Thermal Expansion, per °C., 0-100°C.	.000011	.000012	.000011	.0000103	.0000115

and 8% nickel. Variations of this type, such as 20% chromium-10% nickel and 25% chromium-12% nickel, are similar to the 18-8 grade in that they are normally non-magnetic and not capable of being hardened by heat treatment. However, all the alloys respond to cold working and their strength and hardness can be materially increased in this manner. Combining, as these alloys do, unusual physical properties with remarkable resistance to practically all corrosive agents encountered in domestic and industrial use, they constitute the most widely used group of stainless steels. In the soft or annealed condition, they have excellent ductility and in wire form may be readily cold upset, swaged, formed and woven into screens. Although, the 18-8 free-cutting alloy possesses excellent ductility, it is not so suitable for severe cold upsetting and swaging operations. All of these alloys harden up when cold worked, and, consequently, are somewhat harder on tools than the straight - chromium stainless steels.


Rockwell C Hardness
Ultimate Tensile Strength
17% Cr - 7% Ni. Alloy
18% Cr - 11% Ni. Alloy
Elongation % in 2"
Ultimate Tensile Strength - 1000 P.S.I.
Rockwell 'C'
Elon. %
Percent Reduction of Area

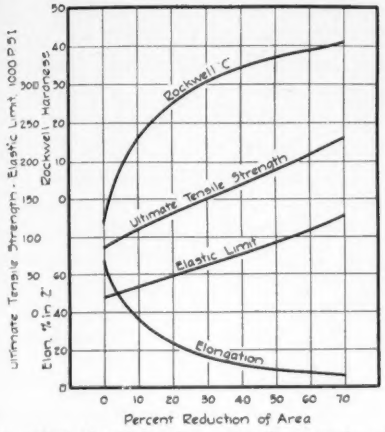
F. Illustrating the difference in work hardening characteristics between low and high alloy 18-8 stainless steel wire.

✦ ✦ ✦

THE chromium - nickel stainless steels have excellent welding characteristics and are more suitable than the straight-chromium grades for applications which involve resistance welding. The 25% chromium - 12% nickel stainless steel, in addition to being highly resistant to corrosion, offers exceptional resistance to scaling at elevated temperatures, as no appreciable oxidation occurs at temperatures under 2000°F.

STRAIGHT CHROMIUM STAINLESS STEELS—NON-HARDENABLE

Stainless Steel Type No.	430	430-F	446
Carbon	.12 Max.	.12 Max.	.35 Max.
Chromium	14.00-18.00	14.00-18.00	23.00-30.00
Nickel	.50 Max.	.50 Max.	1.00 Max.
Sulphur		.15 Min.	
Ultimate Tensile Strength—1000 P.S.I.	75-100	75-100	75-85
Yield Strength—1000 P.S.I.	45- 90	45- 90	50-60
Elongation % 2"	35- 10	34- 8	35-30
Rockwell Hardness	"B"75-100	"B"75-100	"B"75-90
Specific Gravity	7.71	7.71	7.54
Electrical Resistance, Microhms/CM³	60.0	60.0	67.0
Thermal Conductivity, C.G.S. Units at 100°C.	.055	.055	.050
Thermal Expansion, per °C., 0-100°C.	.0000115	.0000115	.0000106



G. Effect of cold drawing on tensile properties of annealed 18-12-3% molybdenum stainless steel wire.

THE stainless steel having greatest resistance to corrosion is the 18% chromium-12% nickel, 3% molybdenum grade, which is highly satisfactory for applications involving exposure to sulphite liquors and weak solutions of reducing acids which ordinarily seriously corrode the other stainless steel alloys. In addition, this grade is particularly resistant to the so called "pitting" form of corrosion which occasionally occurs when the stainless steels are exposed to severe conditions.

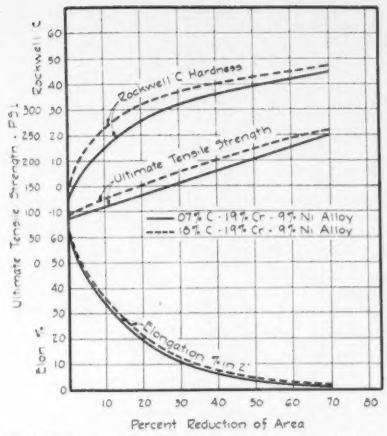
✦ ✦ ✦

ALTHOUGH stainless steel was made and used in this country in 1911, it was about 1926 before any large commercial use was made of the then new material. Since 1929 the output of stainless steel ingots has increased from 55,000 tons to over 156,000 tons in 1937, the year of greatest production. Last year ingot production dropped to about 95,000 tons and out of this was produced over 56,000 tons of finished product, such as sheets, plates, bars and wire. At the present time, wire comprises a small proportion of stainless steel production, amounting to only 3,518 tons in 1938, or 6.2% of the total rolled tonnage. From a tonnage standpoint, this is infinitesimal when compared with the reported production of over 2½ million tons of ordinary steel wire in 1938. However, from a dollar value standpoint, this tonnage of stainless steel wire assumes considerable importance, as it represents a sales value of over 3½ million dollars.

✦ ✦ ✦

THERE are over 60 grades of stainless steel commercially available, but most of the wire produced is in two grades; 18% chromium (low carbon) and 18% chromium-8% nickel. Other grades such as: 12% chromium, 12% chromium-2% nickel, 20% chromium-10% nickel, 18% chromium-12% nickel-3% molybdenum, 25% chromium-12% nickel, 25% chromium-20% nickel are drawn into wire, but the tonnage produced is small compared with the first two grades mentioned. Due to its better all round properties, the 18-8 alloys are the most widely used in wire form. However, the straight chromium alloys, especially the 18% chromium grade, are receiving considerable attention by users who are seeking a more economical stainless material.

✦ ✦ ✦


Rockwell C Hardness
Ultimate Tensile Strength
.07% C - 19% Cr - 9% Ni Alloy
.16% C - 19% Cr - 9% Ni Alloy
Elongation % in 2"
Percent Reduction of Area

H. Illustrating the influence of carbon content on the work hardening characteristics of 18-8 stainless steel wire. ✦ ✦ ✦

Manufacturing Processes

IN the manufacture of stainless steel wire, it is general practice to compound the raw products, base scrap, stainless scrap, chrome ore or ferrochromium and nickel, in an Heroult type electric furnace or in an induction furnace. When the charge is melted and refined, it is tapped from the furnace and cast into ingots which usually weigh about 1000 pounds.

✦ ✦ ✦

Heat Treating Ingots

THE ingots are subsequently heated in furnaces or soaking pits to a uniform temperature of about 2050-2150°F., and reduced on a blooming mill, to a section approximately 3" square. This section is hot sheared into smaller lengths for subsequent operations, so that one ingot may make from 6 to 8 billets, the number depend-

CHROMIUM-NICKEL STAINLESS STEELS

Stainless Steel Type No.	302, 304, 308	303	316, 317	309, 309S
Carbon	.12 Max.	.20 Max.	.09 Max.	.20 Max.
Chromium	18.00-22.00	18.00-20.00	16.00-20.00	22.00-26.00
Nickel	8.00-12.00	8.00-10.00	14.00 Max.	12.00-14.00
Sulphur		.15 Min.		
Molybdenum			2.00- 4.00	
Ultimate Tensile Strength—1000 P.S.I.	85-350	85-150	85-225	100-250
Yield Strength—1000 P.S.I.	35-300	35-100	50-200	50-200
Elongation % 2"	60- 5	55- 35	55- 5	45- 5
Rockwell Hardness	"B" 75-"C" 50	"B" 75-"C" 35	"B" 75-"C" 45	"B" 80-"C" 45
Specific Gravity	7.93	7.93	7.98	7.88
Electrical Resistance, Microhms/CM³	71.0	71.0	75.0	78.0
Thermal Conductivity, C.G.S. Units at 100°C.	.048	.048	.050	.035
Thermal Expansion, per °C., 0-100°C.	.0000171	.0000171	.0000165	.0000149

ing on the weight of wire coil desired.

✦ ✦ ✦

Grinding Billets

IN order to produce a high quality stainless steel wire rod, it is necessary that all surface imperfections, as well as hot roll scale, be removed from the billets. The most satisfactory method of doing this is to grind all over with swing-frame grinders equipped with bonded abrasive wheels. In most cases, grinding to a depth of .003"-.005" is generally sufficient to prepare the surface for subsequent hot rolling operations.

✦ ✦ ✦

Hot Rolling Wire Rods

IN rolling to wire rods, the conditioned billets are heated as rapidly as possible to the rolling temperature (2000-2150°F.), and reduced on a conventional rod mill to a ¼" round, which is coiled as it comes from the mill.

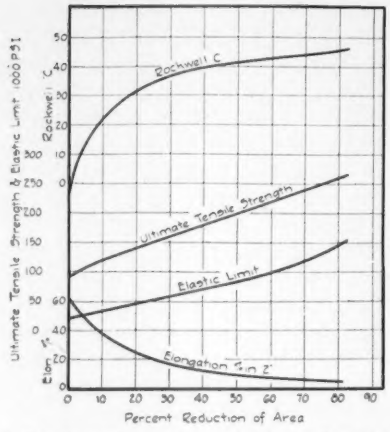
✦ ✦ ✦

UP to this point, all the stainless steels are handled in much the same manner and no difficulty is experienced in hot rolling if proper temperatures and heating cycles are used. However, considerable difficulty is experienced at times in hot rolling the high-chromium — high-nickel alloys, such as 25% chromium - 12% nickel, especially when reducing from ingot to billet. In such cases it is customary practice to first forge to a bloom about 6" square, which can usually be hot rolled without difficulty.

✦ ✦ ✦

Cleaning the Rod

THE wire rod as it comes from the mill is covered with scale and is quite hard, especially the air hardening grades; and before drawing into wire, it is necessary to soften the metal and remove the scale. The hardenable grades are softened by heating in the range of 1500-1550°F., and slowly cooled to about 1300°F., and then air cooled to room temperature. Annealing of the 18% chromium and 27% chromium grades is accomplished by heating to 1425°F. and water or air quenching. However, it is necessary to heat the chromium-nickel grades to 1900-2100°F. and water quench to effect full softening. For scale removal it is customary to use a hot solution of sulphuric or hydrochloric acid, followed by a dip in a cold nitric--hydrofluoric acid solution to clean and brighten the surface. After inspection for surface defects and hardness tested, the annealed and pickled coils are given a lime or metallic coating for subsequent cold drawing operations.



I. Tensile properties of annealed low carbon 18-8 wire after various percentages of cold reduction.

✦ ✦ ✦

Dies for Drawing

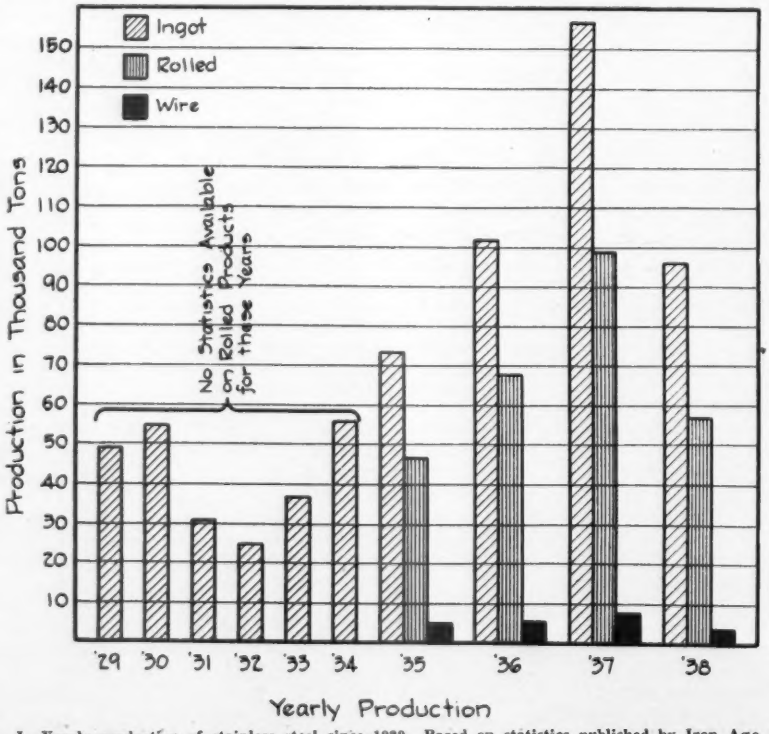
FOR drawing stainless steel wire, it is customary to use Tungsten carbide dies for sizes down to about .035". Under this size, diamond dies are generally used. The amount of reduction which can be taken on one or a series of passes depends on the type of alloy being drawn and the tensile properties desired in the finished wire. For instance, it is possible to take heavier reductions on the straight chromium stainless steels since these alloys do not work harden to the same extent as the 18-8 grades. However, in practice about the same percentage or reductions are used on both types, as heavy reductions lower die life.

✦ ✦ ✦

Typical Processing Procedure

A TYPICAL processing procedure for making either 18% chromium or 18-8, annealed wire from ¼" hot rolled coils, is as follows:

1. **Anneal, pickle and lead coat.**
2. **First pass, .250" to .200".**
   Second pass, .200" to .170".
   Third pass, .170" to .140".
3. **Remove lead coating, bright anneal and lead coat.**
4. **First pass, .140" to .120".**


Ingot
Rolled
Wire
No Statistics Available on Rolled Products for these Years
Production in Thousand Tons
'29 '30 '31 '32 '33 '34 '35 '36 '37 '38
Yearly Production

J. Yearly production of stainless steel since 1929. Based on statistics published by Iron Age and American Iron & Steel Institute.

✦ ✦ ✦ ✦ ✦

Second pass, .120" to .105".
Third pass, .105" to .090".

5. Remove lead coating, "Bright Anneal", Test burlap and ship.

✦ ✦ ✦

THE reduction in each pass amounts to approximately 25% and the speed of drawing customarily used is 100-125 feet per minute, although higher speeds are often used.

✦ ✦ ✦

IN the making of rope and spring wire from 18-8, much heavier reductions are used as high strength in this material is obtained through cold working. The total reduction may amount to as much as 95% of cross-sectional area in some cases.

✦ ✦ ✦

Lubricants and Coatings

MANY types of coatings have been used with success in drawing stainless steel wire, including lead, lead alloy, copper, soap-lime and grease. It is general practice to use lead or lead alloy coatings for all roughing passes and grease, copper or soap-lime for finishing. On cold heading wire the finishing coat is not removed as it serves as a lubricant during cold heading and prevents galling of dies. Copper is applied by plating from a copper cyanide solution, lime by dipping, and grease or soap is drawn on as the wire passes through the die box.

✦ ✦ ✦

Process Annealing

FOR process annealing of stainless steel wire between cold drawing operations, continuous strand type furnaces with provisions for "bright" annealing are generally used. The annealing temperature and speed of wire passing through the furnace depends upon the grade and size of wire being treated. 18-8 requires a temperature of 2000°F., and for .150" round wire a speed of 12 feet per minute in a furnace having a 30 foot heating zone will accomplish full annealing. A good rule is to adjust speed so that wire is in the heating zone for one second per .001" of wire diameter.

Packing

STAINLESS steel wire in sizes above about .030" diameter is usually furnished in coils, and below this on spools. Finishes available include pickled, "bright" annealed, bright cold drawn, metallic coated and polished.

✦ ✦ ✦

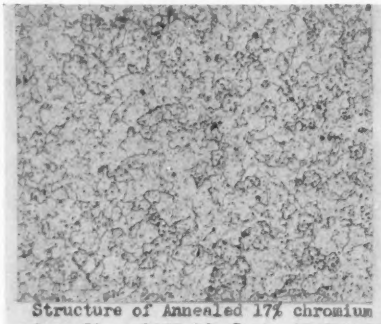
Metallurgical Control

PRACTICALLY every application for stainless steel wire embodies some special requirement in the way of analysis, temper or finish. Due to this, it is essential that a close metallurgical control be kept on the wire as it progresses through the plant. Routine inspection includes hardness, tensile and bend test, and in special cases twist and fatigue endurance properties. In addition to metallurgical tests, wire is carefully inspected for size and finish before shipment.

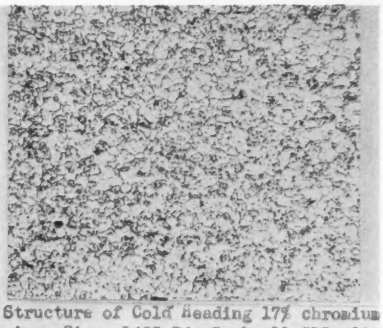
✦ ✦ ✦

Uses of Stainless Steel Wire

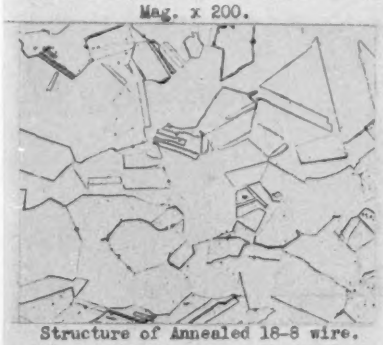
EVERY major industry is using stainless steel wire in some form or is utilizing products made from it. To mention a few, the automobile industry is using 18-8 and 12-2 wire for steering wheel spokes and auto radio aerials. Also, screws made of 18% chromium stainless steel wire are extensively used for fastening door handle and



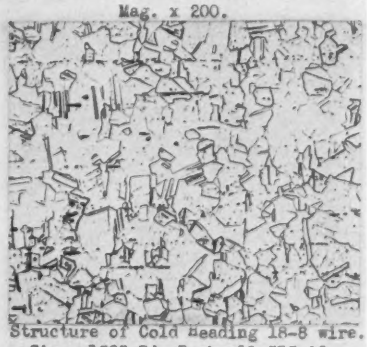
Structure of Annealed 17% chromium wire. Size .165" Rd. Rockwell "B" 75. Mag. x 200.



Structure of Cold Heading 17% chromium wire. Size .145" Rd. Rockwell "B" 85. Mag. x 200.

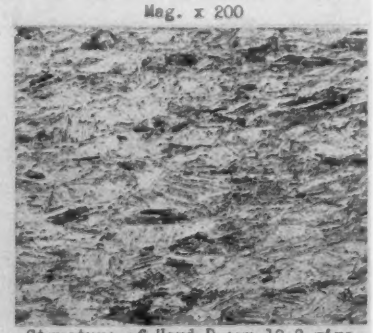


Structure of Annealed 18-8 wire. Size .207" Rd. Rockwell "B" 75. Mag. x 200



Structure of Cold Heading 18-8 wire. Size .152" Rd. Rockwell "B" 90. Mag. x 200

Structure of Annealed 18-8 Free-Machining wire. Size .150" Rd. Rockwell "B" 78. Mag. x 200.



Structure of Hard Drawn 18-8 wire. Size .145" Rd. Rockwell "C" 45. Mag. x 200.

Fig. A1. Ingots for making stainless steel wire are cast with a hot top and generally weigh about 1000 pounds. ✦ ✦ ✦

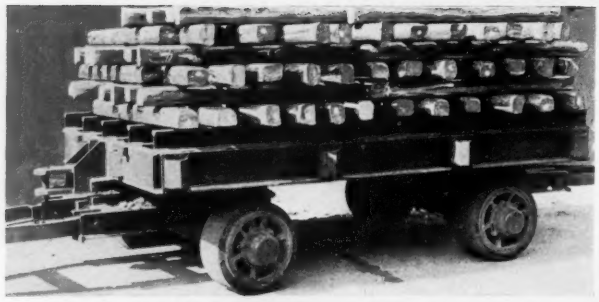
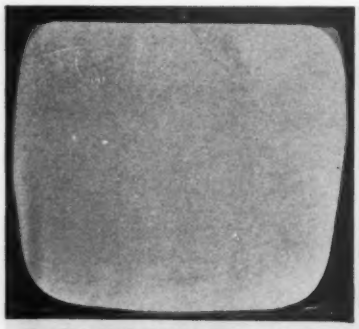


Fig. 1. Stainless steel wire billets weigh approximately 100 pounds and are carefully ground all over prior to rolling into wire rods. ✦

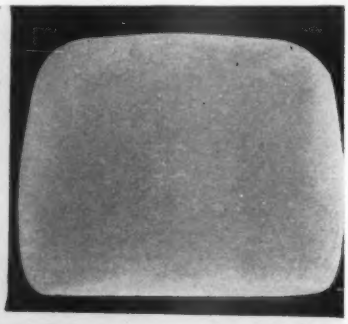
head light brackets and inside moulding trim. In the food and meat packing industry, 18-8 wire is used for bacon hangers, sausage molds and curing racks. Screws, rivets, cotter pins, wire cables and tie rods made of stainless steel are extensively used by the aeronautical industry.

✦ ✦ ✦

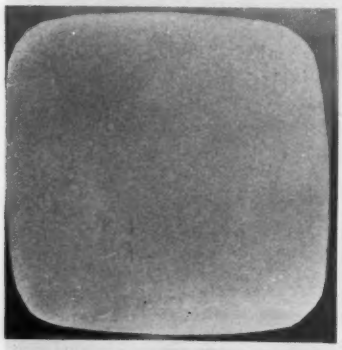
THE building industry uses stainless steel nails for attaching light colored composition shingles. The die casting industry uses stainless wire for ejector pins; the electrical industry for armature banding wire and lead-in wires on radio tubes. Stainless steel wire is used by the Dental and Medical professions for bone surgery, ligature wire and orthodontia. It is used in the brewing industry for filtering; the flour industry for sifting screens; the paper industry for dandy rolls and cylinder facings. The oil industry uses stainless steel wire for oil well strainers, and the refrigerator industry utilizes it in the form of screws for fastening trim on doors and cabinets. In addition, many of the later model refrigerators have a small 18-8 stainless steel wire tray in the meat compartment. Large quantities of 18-8 wire are used in making developing racks for X-ray photographic films.



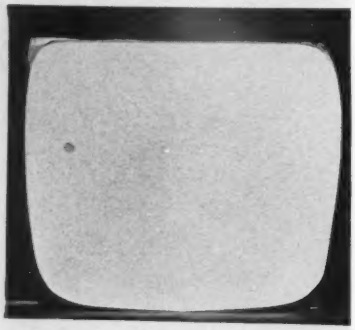
Macro structure of 3" square 18-8 wire billet. Etched in hot 50-50 solution hydrochloric acid



Macro structure of 3" square 18-12-3 molybdenum wire billet. Etched in 50-50 solution hydrochloric acid.



Macro structure of 3" square 12% chromium wire billet. Etched in hot 50-50 solution hydrochloric acid.



Macro structure of 3" square 17% chromium wire billet. Etched in hot 50-50 solution hydrochloric acid.

✦ ✦ ✦

Cold Heading

THE stainless steels are readily cold headed, but the 18-8 grades present some difficulties due to their work hardening characteristics. As most heading is done in closed dies of high carbon steel, the wire should have a lubricating coating drawn onto the surface else galling is apt to occur. This may be copper, grease-lime, soap or oxide, although a copper coated wire which has been given a skin pass drawn through soap, is about the best all round coating for cold heading.

✦ ✦ ✦

IN processing stainless steel wire for making screws and rivets, the wire is drawn .003"-.005" oversize, "bright" annealed, coated and drawn to finished size. The skin pass serves to iron out the coating and slightly raise the temper of the wire which improves heading qualities. However, for making 18-8 nails the wire should be hard drawn to a tensile of 140-150,000 P.S.I. in order that the finished nails be sufficiently stiff for driving. The surface of wire to be used in making screws and rivets must be smooth and free of pits,

otherwise the upset head will be difficult to finish.

✦ ✦ ✦

ALTHOUGH the regular 18-8 analysis cold heads satisfactorily, some advantage is gained by raising the nickel content from 8% to above 10%. The higher nickel serves to reduce work hardening which is conducive to better die performance. In addition, this type material is more suitable for making cap screws which have trimmed heads.

✦ ✦ ✦

STAINLESS steel wire is generally headed on one or two blow

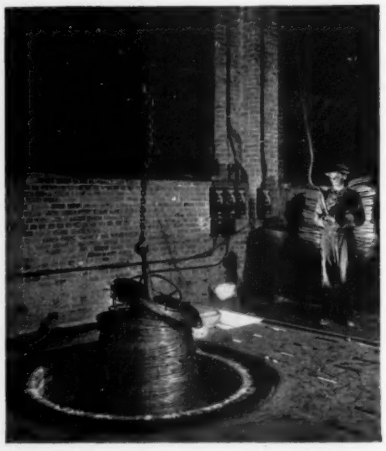


Fig. 3. Annealing hot rolled stainless steel wire rod in pit type furnace. ✦ ✦

headers at speeds ranging from 75 pieces per minute for sizes about 3/8" round up to 225 per minute for smaller sizes. In heading the straight - chromium grades, the expected die life is about one-half that which would be obtained in heading plain carbon steel and is still lower for the 18-8 alloys.

✦ ✦ ✦

Slotting and Roll Threading

IN slotting and roll threading, tools of high speed steel are satisfactory. Slotting speeds range from 20-30 per minute and thread rolling 70-80 per minute.

Fig. 2. Surface conditioning of hot rolled wire billets is accomplished by grinding all over, using swing-frame grinders and special banded abrasive wheels. While such conditioning is expensive it is essential to insure a high quality wire rod. ✦ ✦ ✦ ✦ ✦

✦ ✦ ✦

IN making wood screws and other types requiring cut threads, a free-cutting grade is the most satisfactory, but a proper analysis balance must be maintained, else cracking may occur during cold heading.

✦ ✦ ✦

Screws and Screw Products

MOST users of stainless steel screw products require a high finish, especially on the heads, and may specify an accelerated corrosion test, such as salt spray before acceptance. To meet such requirements, the finished screws must have a high surface finish

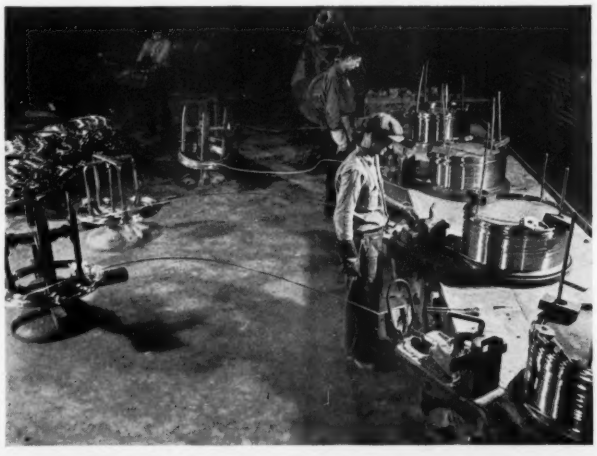


Fig. 5. Cold drawing annealed and coated stainless steel wire rods. ✦

free of lubricants. In finishing screws, it is general practice to tumble the slotted blanks with balls to remove burrs and coating compounds. Tumbling gives a lustrous finish which is satisfactory for most purposes. After tumbling, the threads are rolled or cut as required and tumbled in hardwood sawdust which serves to bring up the lustre. It is not generally necessary to passivate finished screws, but it is sometimes desirable. In such cases im-

Fig. 4. Annealed and pickled 1/4" round 18-8 stainless steel wire rods. ✦ ✦

mersing for a few minutes in a warm 20%-30% solution of nitric acid serves the purpose.

✦ ✦ ✦

STAINLESS steel screws of 18% chromium material are being used by the automotive and refrigerator industries for attaching moulding trim; the aeronautical industry utilizes screws and rivets of 18-8 for assembly purposes; wood screws of 18-8 find wide application in marine construction and nails of 18-8 are being extensively used by the building industry because they

do not rust and discolor white woodwork and shingles.

✦ ✦ ✦

THE wide use of stainless steel sheets and plates has resulted in an increasing demand for screw products to be used in fabricating these forms, and many of these products, such as round, flat, fillister and oval head machine screws, wood screws, sheet metal screws, rivets, cap screws, carriage bolts and set screws are available from stock.

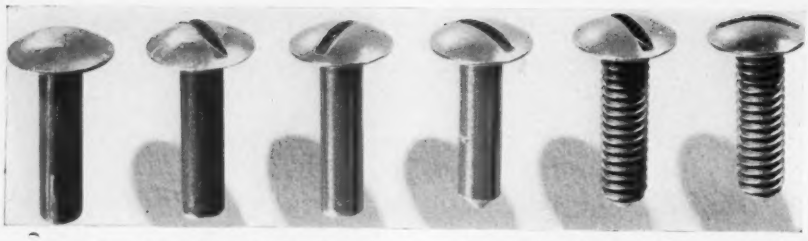


Fig. 6. Various stages in making small machine screw from 17% chromium stainless steel wire. From left to right: headed blank; headed and slotted; headed, slotted and slotted and tumbled; headed, slotted, tumbled and pointed; headed, slotted, tumbled, pointed and threaded; headed, slotted, tumbled, pointed, threaded and burnished. ✦ ✦ ✦ ✦ ✦ ✦

✦ ✦ ✦

Springs

OWING to the ability of the 18-8 stainless steels to work harden when cold drawn. they are well suited for making springs and high tensile wire. The hardenable, straight-chromium grades are also applicable for such uses, but must be heat treated to secure high tensile strength. The tensile strength obtainable by cold drawing 18-8 is closely related to the chromium-nickel content. Maximum tensile strength on cold drawing is secured with an alloy having approximately 17% chromium and 7% nickel and as the alloy content is increased, especially nickel, the capacity to harden by cold working decreases. Charts have been prepared which show the physical properties obtainable on different 18-8 analysis combinations after various reductions, and they make it possible to determine fairly accurately the correct size of anneal wire to draw from in order to secure the desired tensile strength in any given size of finished wire.

✦ ✦ ✦

In processing 18-8 wire for making wire rope and springs, the analysis must be held to a close range if uniform tensile properties are to be obtained. A high fatigue endurance is a desired characteristic in rope wire, especially that used for airplane control cable. Wire for rope making is usually supplied without a coating and tensiles range from about 350,000 P.S.I. on a .007″ diameter wire, down to 250,000 P.S.I. on .100″ diameter wire.

✦ ✦ ✦

18-8 spring wire is processed in the same manner as rope wire and the tensile properties of corresponding wire sizes are approximately the same. The modulus of torsion for 18-8 spring wire averages about 10,500,000 P.S.I., but may vary between 9-11,000,000 P.S.I. The heat treatable grades of stainless steel are more uniform in this respect, but their lower corrosion resistance limits their application. Where 18-8 springs must maintain great accuracy, the recommended maximum operating temperature is 350°F., however, they can be operated at considerably higher temperatures without entire loss of spring properties. For most applications, it is advisable to temper springs made of 18-8 wire in the range of 400°-800°F. in order to increase elastic properties and secure permanent set of dimensions.

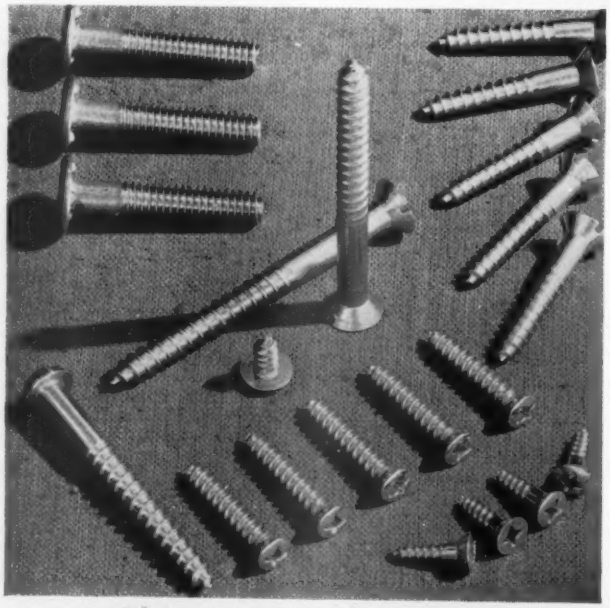


Fig. 7. Many types of screws are being made from stainless steel wire, and a few typical ones are shown above, which include wood, welding head, oval and flat head Phillip's type screws. ✦ ✦ ✦

✦ ✦ ✦

WHERE springs are to be made by winding on a mandrel, it is not usually necessary for the wire to be coated. However, if forming is done on automatic coiling machines, the wire should be coated as well as "cast flat". The coating may be of the oxide or metallic type such as lead, copper or cadmium. Cadmium is preferred as it is not generally necessary to remove it after the springs are formed. Stainless steel springs are used in business and calculating machines, valves, stoves and many other places where conditions are too severe for ordinary steel springs.

✦ ✦ ✦

Rope and Cable

ROPE and cable made from high tensile 18-8 wire is used for control cables on airplanes and for stays on sea-going yachts. The automotive industry uses high tensile 18-8 and 12-2 wire for steering wheel spokes and auto aerials. The electrical industry uses considerable quantities of hard drawn 18-8 for armature banding wire which must have a tensile strength of

200-225,000 P.S.I. and at the same time be practically non-magnetic. Such properties can only be obtained by careful control of analysis and processing. Another interesting application for high tensile 18-8 wire is its use by the paper industry for support wires on cylinders and dandy rolls.

✦ ✦ ✦

Weaving Wire

A LARGE proportion of the present day production of stainless steel wire in sizes under about 1/8" diameter is used for weaving wire cloth, screens and conveyor belts. Most of this wire is of the chromium-nickel types, such as low carbon 18-8, 18-12 with 3% molybdenum, 25% chromium - 12% nickel and 25% chromium-20% nickel. Where corrosion is not particularly severe and operating temperatures fairly low, the 18% chromium alloy merits consideration.

✦ ✦ ✦

FOR weaving the wire should be fully annealed and as uniform in temper and size as possible. Size uniformity is particularly important on fine sizes, as it is difficult to produce screens of accurate mesh unless the wire is almost perfect with respect to roundness and dimension. The tensile strength of 18-8 wire for weaving averages about 100,000 P.S.I. with an elongation of 10" of 50%. Stainless wire of .0021" diameter and finer is being regularly produced for making 200-300 mesh screens.

✦ ✦ ✦

Wire Cloth

WIRE cloth of stainless steel is used in the paper industry for facing cylinder rolls; in the chemical industry for filtering and classifying corrosive products and for numerous applications involving sifting and screening abrasive materials. Another large application is in the form of woven belts for conveying material continuously through brazing and annealing furnaces. The grade used for such purposes depends entirely upon the operating conditions involved, especially temperature. Where the operating temperatures are less than 1050°F., the 18% chromium alloy can be used, but for temperatures over this and up to about 1500°F., the 18-8 grade is usually recommended. Above 1500°F. and up to about 1950°F., is is necessary to use one of the high chromium-nickel alloys, such as 25% chromium-12% nickel or 25% chromium-20% nickel. Strength as well as scaling resistance is an important factor in the life of woven belts operating at these high temperatures.

	Cold Drawn	Cold Drawn 500°F.	Tempered 800°F.
Ultimate Tensile Strength P.S.I.	**240,000**	**250,000**	**265,000**
Elastic Limit P.S.I.	**87,000**	**157,000**	**160,000**
Elongation, % in 2"	**2.5**	**2.5**	**2.5**

✦ ✦ ✦

Screens

VARIOUS types of stainless steel screens are used by the ore and coal industries for screening, sizeing and dewatering materials. Woven screens are generally used for screening and wedge wire screens for dewatering purposes. 18-8 wire is generally used, although in many cases 18% chromium material gives satisfactory service. Stainless steel is rapidly replacing ordinary steel and non-ferrous metals in this field owing to its higher corrosion resistance, coupled with excellent abrasion resisting properties. One service record on wedge wire screen, operating in a coal washer, showed that a screen made of 18% chromium wire was still in service after three years, whereas a similar screen made of a non-ferrous material lasted less than 10 months. In the mining industry where fine mesh screens are used for concentrating wet ores, stainless steel is the only material which is satisfactory, as screens of other metals soon corrode and the openings are "blinded" or clogged, necessitating their removal and replacement.

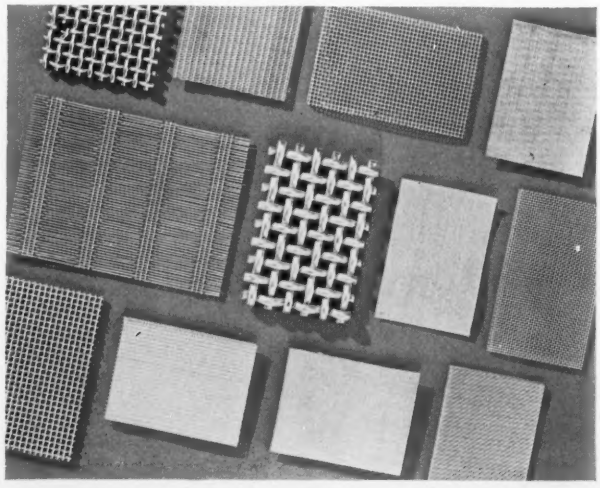


Fig. 8. Some of the many woven screens being regularly produced from stainless steel wire. The coarse screen has a clear opening of 7/8" and was made from .192" round wire. The fine screen has a 200 mesh and .0021" diameter wire was used in weaving. Courtesy W. S. Tyler Company, Cleveland, Ohio.

✦ ✦ ✦

Welding Rods

LARGE quantities of stainless steel wire are being used for making both coated and uncoated welding rods for fabricating stainless steel plates and sheets. In general, such wire is furnished to the rod manufacturers in coils and since temper and finish are not important, it is supplied in the annealed and pickled condition. However, where the wire is to be used for coated rods, the surface must be free of grease and soap.

✦ ✦ ✦

Types of Stainless Steel Used for Wire

THE chromium-nickel stainless steels comprise the bulk of the wire furnished for this applica-

tion and analysis specifications are quite rigid. The carbon must be low, usually .07 maximum and the chromium and nickel content somewhat above the 18-8 range to compensate for losses due to oxidation. In some cases, columbium may be added to the amount of about ten times carbon content to prevent excessive carbide precipitation during welding.

✦ ✦ ✦

Formed or Fabricated Products

FOR uses where fabrication involves severe forming or bending, such as in the making of wire shelves and baskets, the wire should be fairly soft and uniform in temper. In addition, the finish of the wire should be bright to facilitate cleaning after welding. Where resistance welding is used in fabricating wire products, the oxidized metal at the weld joints must be removed by some means, else superficial rusting is apt to occur at these points when the articles are placed in service. Pickling in hot solutions of sulphuric or hydrochloric acids is the method generally used, followed by passivating in a warm nitric acid solution.

✦ ✦ ✦

Steel Wool

FAIR quantities of stainless steel wire are being used for making steel wool. This product is used for scouring pads, steam pressing pads and filters. At the present time it cannot be shredded as fine as ordinary steel, which serves to limit its use. The straight chromium grades are the most satisfactory for making steel wool, as they do not work harden and dull the shredding tools, as is the case with 18-8 wire.

Fig. 9. Large quantities of stainless wire are used for making such products as refrigerator food shelves, sausage molds, bacon hangers and meat hooks.

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Miscellaneous Uses

IN addition to the applications mentioned in the foregoing paragraphs, stainless steel wire is being used for numerous miscellaneous purposes, such as metal spraying, cotter pins, fishing leaders, carboy closure wires and metal sponges, which individually require relatively small quantities, but in the aggregate amounts to a considerable tonnage.

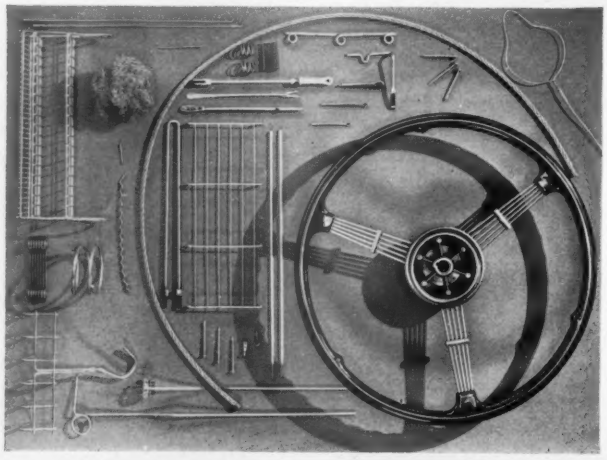

Fig. 10. Showing a few of the many products being produced from stainless steel wire.

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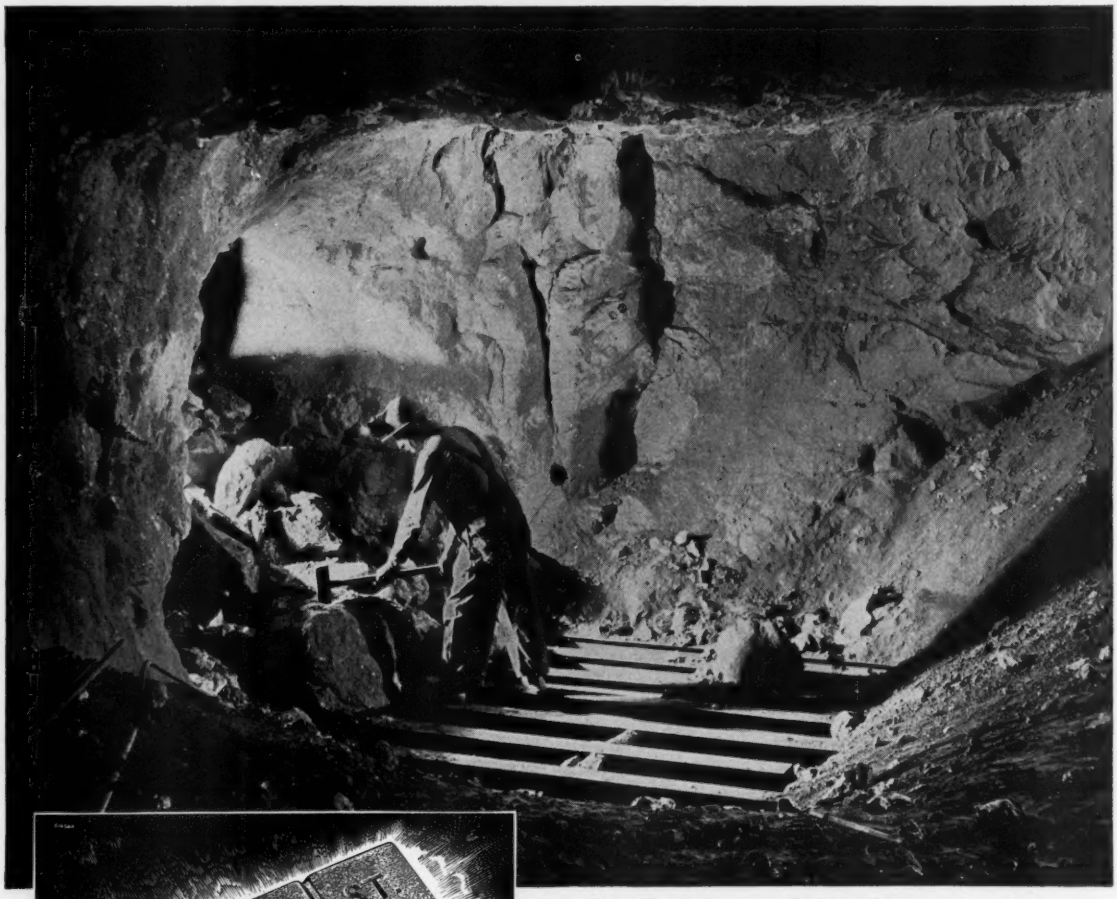
Summary

A LARGE proportion of the 2½ million tons of ordinary steel wire produced last year was given a coating of some sort to prevent rusting, and many of the products made would have had a longer useful service life if stainless steel had been used. Few materials so combine strength and durability, nor have so wide a useful range, as the stainless steels. Their initial cost is more, they require more attention and time in fabricating, and they generally increase tool costs. Consequently, product sales prices must be stepped up, too. But a nice looking appliance, a machine whose built-in performance offers permanence against corrosive conditions, an article which lasts longer and is more satisfactory to its user is worth some extra cost. In short, premium value will exceed the premium in price. The public consciousness of and acceptance for stainless steel is increasing each year, and every new application which goes into service makes its impression on someone, and that someone will not have to be retold of its many advantages over other commonly used metals.

✦ ✦ ✦

FROM ORE TO METAL

The Story of St. Joe Electro-Thermic Zinc—Number 4 of a Series



At the Bottom of the Stope

In the Balmat zinc mine of the St. Joseph Lead Company the broken ore is screened by a steel "grizzly." The larger boulders have to be broken by sledge or powder. This "grizzly" is the first screening operation. The broken ore drops between the steel beams and falls into the underground ore chute. The miner wears a hard hat to protect his head, safety shoes with steel reinforced toe caps to protect his feet, and goggles for eye protection. He works alone in the sub-drift and his function is to keep the broken ore moving toward the haulage level below.

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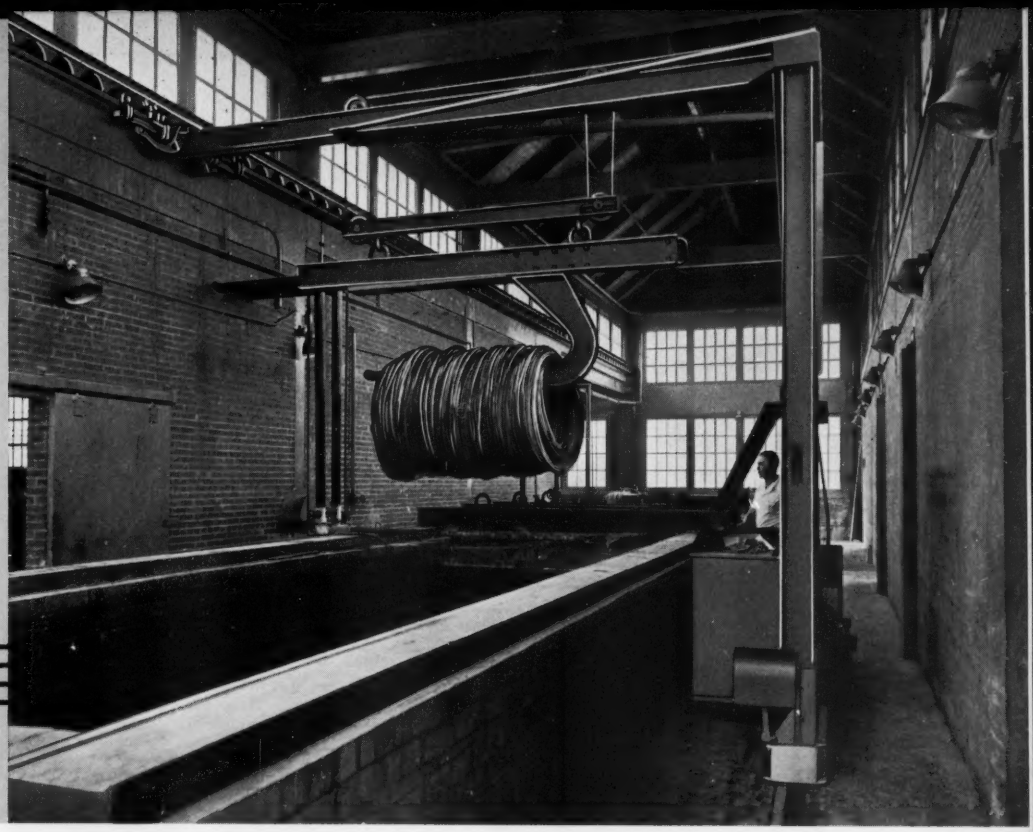

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Initial cost may be high but FIRTHALOY dies are the best in the long run

Electric Resistance Wires

By Dr. C. L. Mantell,
Plant Engineer,
Wilbur B. Driver Company, Harrison, New Jersey

This paper discusses the manufacture of the electrical resistance alloys of which typical examples are the 80% nickel 20% chromium; 60% nickel 15% chromium 25% iron; the 60 nickel 10 chromium 30 iron; the 30 nickel 20 chromium 50 iron; the 35 nickel 17.5 chromium balance iron; and the 30 nickel 5 chromium 65 iron, as well as the 55% nickel 45% copper, and the high-copper, low-nickel content alloys of specific resistance. The paper discusses melting, hot rolling, heavy wire drawing, medium wire drawing, annealing, fine wire drawing, testing, and inspection, with a consideration of the requirements and specifications of these materials in their wide-spread industrial service in electric furnaces, electrical appliances, controllers, and thermocouple uses. A portion of the paper concerns itself with a point which impressed a metallurgical editor whom the author showed through the plant.

"Among many requirements for resistance wire, one apparently simple one has given a lot of trouble. A closely wound helix of (n) turns when pulled out like a spring to (D) distance must acquire a uniform set so that the coils of the resistor in a heater channel will have correct spacing and each distance between turns will be identical with that of its neighbors. Try that on fence wire." ✦ ✦ ✦

MODERN electric heating of the domestic appliance and industrial types is fundamentally dependent upon electric resistance wires. The appliances include toasters, percolators, ironers, ranges, cigar lighters, roasters, broilers, and a multitude of related mechanisms and gadgets, while the industrial applications cover a wide range of annealing, heat treating, ovens, furnaces and kilns, as well as miscellaneous melting equipment.

✦ ✦ ✦

FUNDAMENTALLY, electrical heating applications are dependent upon a rather specific group of nickel-chromium and nickel-chromium-iron alloys, supplemented for low temperature application by nickel-copper materials. These alloys have conveniently high resistivities which will permit the use of rod, wire, or strip of reasonable cross-section for use with the standard voltages available. They show low temperature coefficients of resistivity which are roughly constant between ordinary room and the operating temperatures. They have the prime requisite of resistance to oxidation and scaling up to 1150°C. or 2100°F. for the alloy with the nominal composition of 80 nickel 20 chromium; 1000°C. or 1830°F. for the alloy with the nominal composition 60 nickel 15 chromium balance iron; and 850°C. or 1560°F. for the nominal composition of 30 nickel 20 chromium 50 iron. They show only slight growth at high temperatures and to a satisfactory degree retain their physical properties at these thermal levels. They have relatively high melting points, narrow melting ranges, and do not soften under the conditions of service. They are reasonable in cost in contrast to other materials which might be useful, such as platinum despite its lower resistance, or molybdenum or tungsten which have the disadvantage not only of high cost but of necessity of preservation in an inert or protective atmosphere. With properly regulated alloy composition they show good hot and cold workability so that they are available industrially in a very wide range of commercial sizes, from large hot or cold rolled sections to wire as small as 0.0007 in. diameter in the bare form or in a wide range of coated or insulated conditions.

CHARLES L. MANTELL

Ph.D. is a member of the American Institute of Mining and Metallurgical Engineers, American Institute of Chemical Engineers, American Society for Testing Materials, American Society for Metals, The Electrochemical Society, and the American Chemical Society, in all of which he has been active and at various times presented technical papers. He was educated at McGill and Columbia Universities. After army service, he was connected with the Aluminum Company of America. Since 1924 he has been a consulting engineer and has been responsible for the design of metallurgical and electrochemical plants in many portions of the world. He is the author of over a hundred technical publications and volumes. From 1934 to 1939 he spent a considerable portion of his time as Technical Director for the Gilby Wire Company and its successor, the Wilbur B. Driver Company, becoming consulting engineer for that organization in June, 1939. His headquarters is at 360 Furman Street, Brooklyn, N. Y.

✦ ✦ ✦

THE manufacture of modern high quality electrical resistance alloy wires is one of the most

TABLE 1

No.	Name or Class	Composition Ni	Cr	Fe	Resistance Ohms CMF	Temp. Coeff. °C (20-100°C.)	Oxidation Res. up to °C.	Melting Point °C.	Strength at High Temp.	Growth at High Temp.	Specific Heat	Tensile Strength Lb./sq. in. Min.-Max.
1	Tophet A	80	20	..	650	0.0001	1,150	1,390	Excellent	Slight	0.104	80,000-200,000
2	Tophet C	60	16	24	675	0.00013	1,000	1,350	Excellent	Slight	0.107	95,000-175,000
3	Tophet D	30	20	50	600	0.0003	850	1,400	Good	Slight	0.114	75,000-160,000
			Cu									
4	Cupron	45	55	..	294	±0.00002	500	1,299	Good	Slight	0.094	62,000

exacting and fussiest of metallurgical problems. The resulting product must meet specifications which call for close tolerance values of physical properties such as tensile strength, elongation, torsion, bending, hardness and temper, low creep values at high temperatures, and resistance to fatigue. In addition, the wire must possess niceties of electrical resistance, temperature coefficients of this value, conform closely to gauge and mechanical requirements, perform satisfactorily under accelerated tests for "life", as well as have all the necessary qualities of uniformity, freedom from mechanical, physical, and chemical defects so as to allow it to be coiled in a helix form which can be stretched so that every turn is equi-distant from adjacent turns and the spacings between turns are equal. It is obvious that such a product can only be produced under step-by-step control and inspection from original metal through the ingots to the spool of finished wire. Such has been the attention to details and minutae that there has been a thirty-fold improvement in life of resistance alloy wires in the past seven years.

✦ ✦ ✦

THE Wilbur B. Driver Company has been outstanding in this march of progress, and the production of their Tophet and Cupron alloys will be described. The properties of these alloys are given in Table 1.

THE plant is completely integrated. It consists of a melting shop, hot mill, heavy wire mill, and fine wire plant with its attendant subdivisions for the production of different shapes and coated finished products. In the melting shop electrolytically refined materials or electrothermically produced products are melted together in high frequency induction furnaces. Exacting melting records are kept in detail, including furnace charges, all operation conditions, molds employed, etc. The ingots meet the analysis specifications of the **American Society for Testing Materials,** given in Table 2. All metals are purchased on analysis and converted into ingots in accordance with manufacturing specifications.

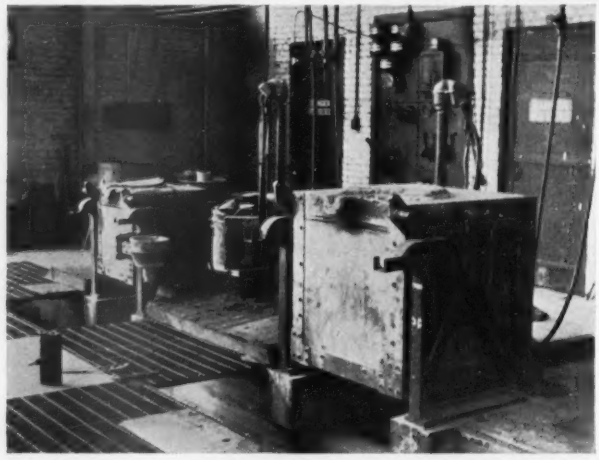

Fig. 1. Corner of melting shop, showing some of the high frequency induction furnaces and ingot pit. ✦ ✦ ✦ ✦

✦ ✦ ✦

THE production of wire with satisfactory life performance

Fig. 2. Casting an ingot. ✦ ✦

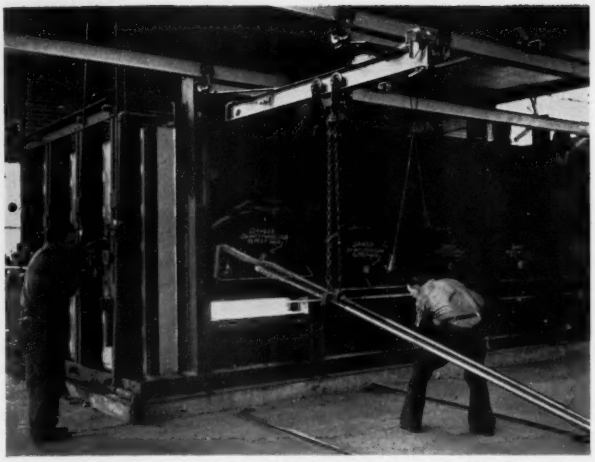

Fig. 3. Hot ingot transfer from furnace to cogging mill.

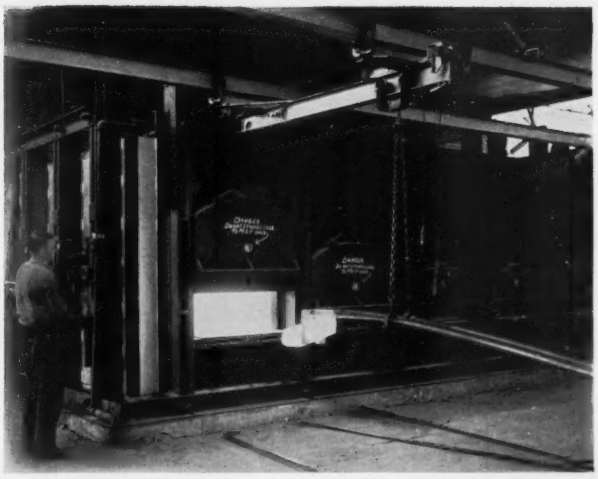

Fig. 4. Ingot Soaking. The bright smooth-surfaced ingot is heated with many others between 2200 and 2300 deg. F. for 8 hrs. in this oil-fired, automatically controlled Electric Furnace Co. unit, then transferred to the cogging mill.

TABLE 2

	A. S. T. M. Spec. B 82 - 39 A Alloy	A. S. T. M. Spec. B 83 - 39 C Alloy
Nickel	77 - 79	57 min.
Chromium	19 - 20	14 - 18
Iron	1.0 max.	Balance
Manganese	2.5 max.	3 max.
Carbon	0.25 max.	0.25 max.
Silicon	0.75 - 1.5	0.75 - 1.5
Sulphur	0.03 max.	0.03 max.

at high temperatures depends upon clean, sound, gas-free, workable ingots of controlled grain size. Complications in melting are introduced by the high vapor pressure and oxidizability of the chromium and the absorption affinity of nickel for hydrogen and sulphur, both of which are deleterious. In addition, the constituent metals have high melting points. The nickel-chromium and nickel-chromium-iron alloys are unusual, in that many of their properties and their metallurgical

Fig. 5. Nickel chrome alloy rod—⅜" diameter. (Note rod surfaces)

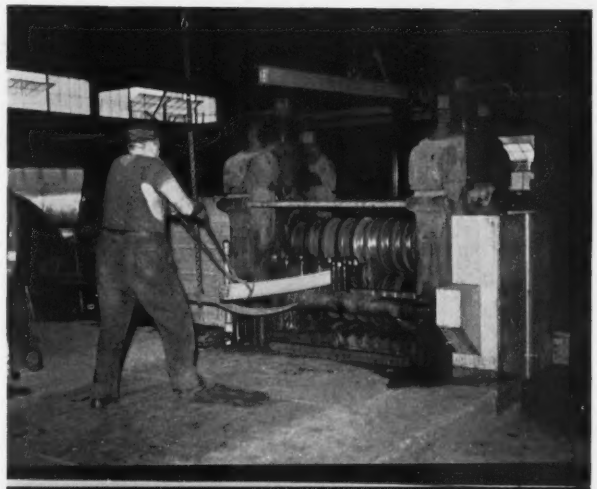

Fig. 5. Ingot cogging to billets 2" square.

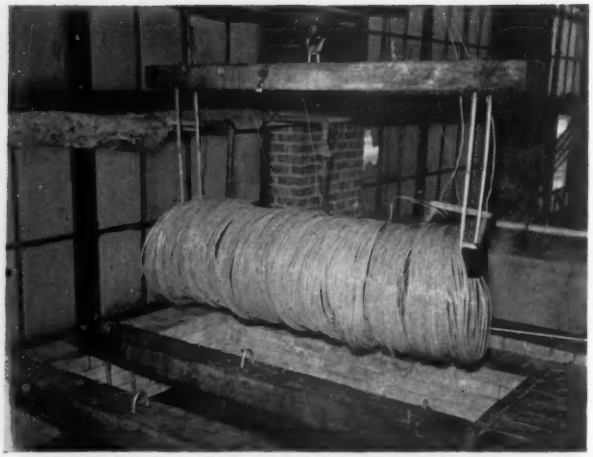

Fig. 6. Rod Pickling is done in a strong hydrochloric acid solution, an operation that is no simple matter of "dunk and rinse" with these extremely acid-resistant alloys. Note acid resistant ceramic lined tanks of heavy construction. Support rods are nickel chromium alloys. ✦

Fig. 7. Salt annealing. Coils of wire are held in place on frames. ✦ ✦

phenomena are developed not primarily through their major constituents, but through extremely small quantities of other ingredients which might ordinarily be classed as impurities of no consequence. Additions of minute amounts of grain refiners or protective elements must be carefully controlled, otherwise cleanliness and workability are affected. The melter is sometimes "between the devil and the deep blue sea," in that constituents added to improve workability may reduce the service life of the alloy. Exhaustive experimental melting has determined the effect of practically every metal in the periodic table of the elements.

✦ ✦ ✦

INGOTS carry identifying numbers and are followed throughout all their operations in the plant. At the time of casting, fingers or "coupons" are produced and converted into wire for test. If satisfactory, the ingot passes on to the hot mill. Here the casting skin is removed and the ingot conditioned for hot working. After soaking in a regulated atmosphere furnace, the ingot is cogged to 2 x 2 billets, hot top and ends having previously been sheared off. Billets are inspected for seams, and cracks, and cross-sections are etched for examination for dirt, pipes, etc. The billets are ground and surfaced and after billet soaking pass to a billet break-down mill and then to a rod mill which produces ⅜ or ¼ in. rod. Each rod carries an identification tag and number for process control. The rods are carefully inspected for seams, cracks, and bad ends, to insure complete soundness, and rod cross-sections are etched and examined microscopically for dirt, seams, and cracks. Cropped, inspected rod is sampled and the samples worked down to wire sizes for life testing.

✦ ✦ ✦

Fig. 8. Heavy Drawing. (Rod Breakdown). The heavy drafts are all made through carbide dies; lubrication is provided by previously coating the pickled rod with a special metallic lubricant; in addition, a small amount of graphite is picked up in the die-box. The illustration shows the first drawing operation with the ⅝" rod passing through the carbide die.

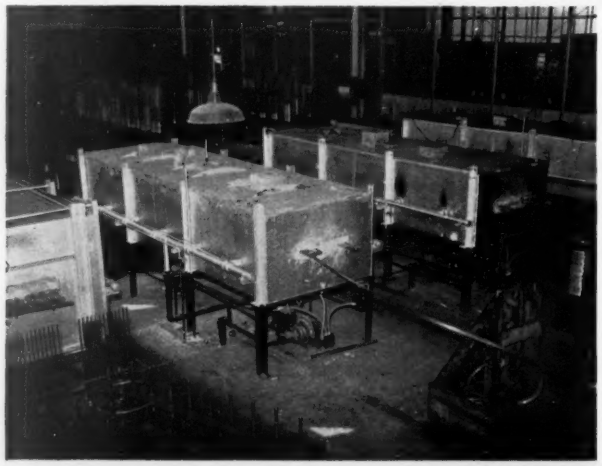

Fig. 9. Strand Annealing of medium heavy stock—Atmosphere Controlled Furnaces. ✦ ✦ ✦ ✦ ✦ ✦

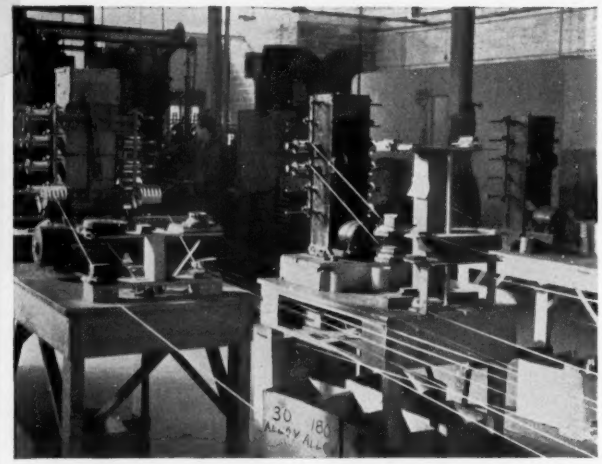

Fig. 10. Take-ups on strand annealing furnaces. ✦ ✦

SATISFACTORY rod goes on to the heavy wire mill. Here it is annealed either in salt in nickel-chromium pots or in controlled atmosphere furnaces, pickled and surfaces inspected, and metallic lubricant added. It is broken down through carbide dies by single holing on heavy Scudder benches to 0.114, when it is cleaned, decoated, re-annealed, pickled and recoated, and then either drawn down by single holing to 0.080 through carbide dies and then continuously from 0.080 to 0.036, or else continuously drafted from 0.114 to 0.036. Drafting speeds, die and size tolerances of the wire at each stage are the subject of exacting manufacturing procedures.

✦ ✦ ✦

AT this stage, the wire is decoated and cleaned and strand annealed in hydrogen or reducing gas atmospheres in horizontal furnaces. The atmosphere gases are subjected to intensive purification operations so that bright, tarnish-free annealed products are possible. Only by actual contact with the industry can an appreciation be had of the immense difference between scale-free and tarnish-free annealing. Practice has been perfected to the point where there is zero surface change on the wire as the result of annealing operations.

✦ ✦ ✦

FROM 0.036 down to finished sizes, drawing is carried on in vertical Waterbury units continuously to the desired customer size. The wire is then subjected to cleaning and controlled atmosphere annealing, again with zero surface change. Very fine wire down to 0.0007 is produced continuously with trains of dies in modified tub and roller units developed in the plant.

Fig. 11. Strand annealing furnaces. ✦

✦ ✦ ✦

FINE wire is drawn by the use of diamond dies made in the Die Department of the plant. These are manufactured to predetermined sizes with definite control of entrance and exit angles, bearing length, and surface polish. They are continually subjected to examination by high powered optical equipment. In decided contrast to the practice in many wire drawing plants where only the finishing die is considered to be of major importance as a factor in gauge control, every die in the train must be in as near perfect condition as possible. The alloys being drawn are relatively hard, tough, and of high tensile strength. As a result, diamond quality requirements

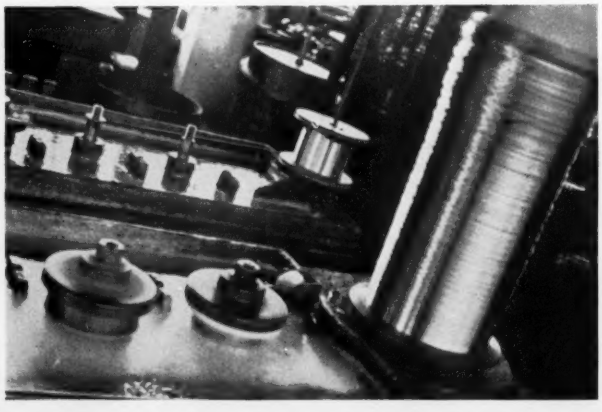

Fig. 12. Fine wire drawing. ✦ ✦ ✦ ✦

Fig. 13. Continuous drafting on Waterbury Machines. ✦ ✦

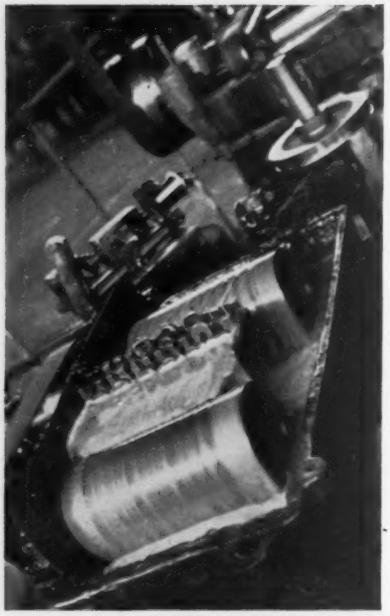

Fig. 14. Very fine wire drawing. ✦

are much higher and more severe than almost any other section of the wire industry.

✦ ✦ ✦

ELECTRICAL resistance wire is in a class by itself, in that while wire in coils or on spools is sold, actually the customer is buying resistance units or ohms. As a result, the wire is drawn not only to size but also to resistance. The customer is buying ohms per pound and writes not only size but also specific resistance of the alloy and resistance in ohms per foot in his specifications. Illustrative of

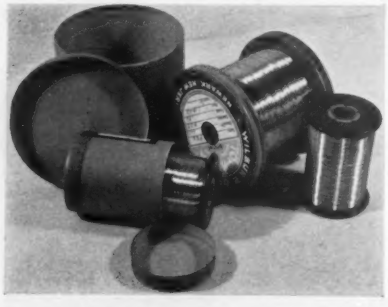

Fig. 15. Finished Product. The large spool shown here holds about 5 lbs. of 0.020 in. wire, the small spools about 2 lbs. of 0.010 in., each. The original 300-lb. ingot was 3 ft. long; at 0.003 in., the size of wire used in many very small resistance units, the length of wire drawn from the original ingot would be about 2000 miles.

In addition to its familiar application as domestic appliance heater wire, nickel-chromium alloy is widely used industrially: Bar stock for furnace parts; rod and heavy wire for furnace resistors; medium-size wire for rheostats and, in the chemical industry, for dipping baskets and filter cloth; and fine wire for electronic tube grids, instrument resistances, and many other applications. ✦

"TOPHET A" WIRE

(Resistances and Weights) Specific Gravity 8.40
Resistivity 650. ohms per circular mil foot at 20°C. (68°F.)
Wt. per cubic inch=.304 lbs.
***Factors for Determining Resistance at Various Temperatures**

Temperature °C	20	100	200	300	400	500	600	700	800	900	1000
Temperature °F	68	212	392	572	752	932	1112	1292	1472	1652	1832
Factor	1.000	1.017	1.035	1.052	1.060	1.068	1.066	1.063	1.062	1.067	1.071

*These figures will vary slightly with various sizes of wire due to rate of cooling.

B&S	Dia. in Inches	Ohms Per Ft. at 68°F (20°C)	Ohms Per Pound Bare Wire	Feet Per Pound Bare Wire	Weight Per 1000 Feet Bare Wire Pounds
1	.289	.007782	.03294	4.228	236.5
2	.258	.009765	.05164	5.280	189.4
3	.229	.01239	.08281	6.678	149.3
4	.204	.01562	.1318	8.446	118.4
5	.182	.01962	.2082	10.62	94.20
6	.162	.02476	.3334	13.39	74.66
7	.144	.03135	.5322	16.95	59.00
8	.128	.03967	.8520	21.46	46.60
9	.114	.05001	1.352	27.03	37.00
10	.102	.06248	2.111	33.78	29.60
11	.091	.07849	3.323	42.28	23.65
12	.081	.09907	5.313	53.56	18.67
13	.072	.1255	8.509	67.80	14.75
14	.064	.1588	14.88	85.83	11.65
15	.057	.2000	21.64	108.2	9.240
16	.051	.2499	33.76	135.1	7.400
17	.045	.3209	55.71	173.6	5.760
18	.040	.4062	89.28	219.8	4.550
19	.036	.5015	135.9	271.0	3.690
20	.032	.6347	217.8	343.1	2.915
21	.0285	.8002	348.8	435.9	2.294
22	.0253	1.017	562.8	553.4	1.807
23	.0226	1.272	875.4	688.2	1.453
24	.0201	1.609	1,413.	878.0	1.139
25	.0179	2.029	2,228.	1,098.	.9110
26	.0159	2.571	3,576.	1,391	.7190
27	.0142	3.228	5,623.	1,742.	.5740
28	.0126	4.090	9,010.	2,203.	.4540
29	.0113	5.090	14,257.	2,801.	.3570
30	.010	6.500	22,848.	3,515.	.2845
31	.0089	8.206	36,426.	4,439.	.2253
32	.008	10.16	55,789.	5,491.	.1821
33	.0071	12.90	89,965.	6,974.	.1434
34	.0063	16.37	144,989.	8,857.	.1129
35	.0056	20.72	232,230.	11,208.	.08922
36	.005	26.00	365,534.	14,059.	.07113
37	.0045	32.09	557,307.	17,367.	.05758
38	.004	40.62	892,340.	21,968.	.04552
39	.0035	53.06	1,523,830.	28,719.	.03482
40	.0031	67.63	2,476,408.	36,617.	.02731
	.00275	85.98	4,040,372.	46,992.	.02128
	.0025	104.00	5,859,152.	56,338.	.01775
	.00225	128.5	9,030,209.	70,274.	.01423
	.002	162.5	14,279,363.	87,873.	.01138
	.00175	212.4	24,396,901.	114,863.	.008706
	.0015	288.9	45,168,937.	156,348.	.006396
	.0014	331.6	59,459,000.	179,310.	.005577
	.0013	384.6	79,994,000.	207,940.	.004809
	.0012	451.4	110,177,000.	244,080.	.004097
	.0011	537.2	156,024,000.	290,440.	.003443
	.001	650.0	228,471,100.	351,494.	.002845

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HOW WILL THEY AFFECT OUR PRODUCTION?

WHAT WILL THEY COST?

HOW WILL THEY FIT INTO OUR PRESENT EQUIPMENT LINE-UP?

WILL THEY IMPROVE QUALITY?

WILL THEY DEFINITELY LOWER OUR COST PER TON?

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HERE'S HOW
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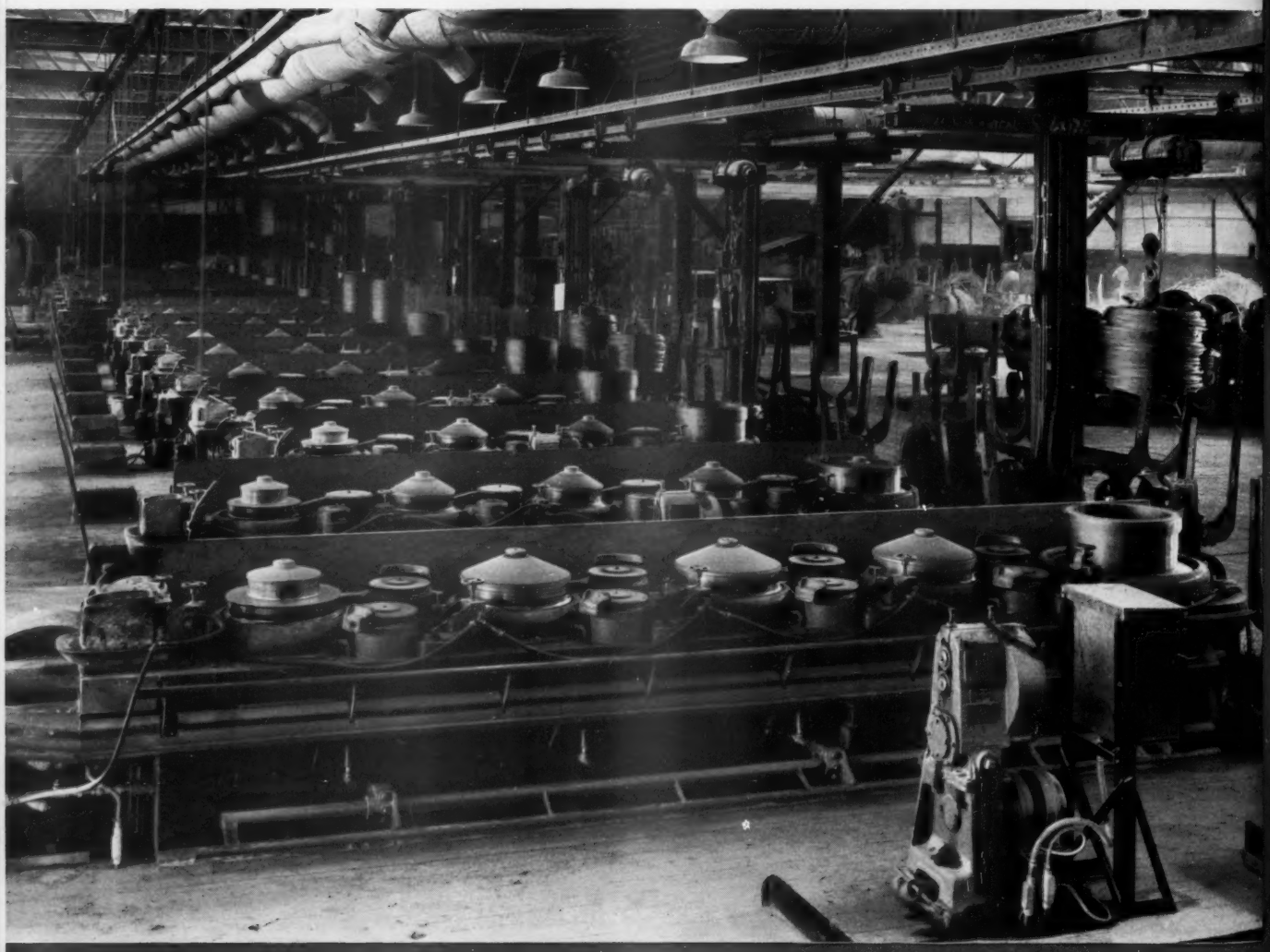
In this up-to-the-minute Motoblox and Motobloc installation you see an interlocking group of machines that provide straight line handling with wide flexibility for drawing wire from one to six holes.



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THE FINEST ALL-AROUND WIRE DRAWING EQUIPMENT YOU CAN BUY!

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VAUGHN Wire Drawing Machinery *answers in performance* every question you can ask regarding the benefits of this modern equipment to your operations. Vaughn MOTOBLOX and MOTOBLOC have the *better design* that makes this performance possible—and follow through with *better construction* that safeguards your investment during their long service life. Vaughn design and construction are solidly based on close and continual contact with the wire manufacturer's problems in every field, and the many advanced features you find today in Vaughn Machinery are there because the industry has demonstrated definite need for them.

When you install Vaughn Wire Drawing Machinery, you notice immediately an impressive difference in the speed and quality of your production . . . in safety, reliability and true flexibility. And when you check on tonnage costs, you'll find a gratifying difference there! You'll see how faster handling has moved to offset your rise in labor costs, and how you've gained in greater production despite your shortened working periods.

You can also check the advantages of MOTOBLOX and MOTOBLOC *safety*—and read on the books savings in compensation costs and delays formerly occurring with less-protected machines. And remember that these benefits, all of them—including more rapid deliveries, with promises dependably kept—are furnished by Vaughn Machinery without presenting installation or maintenance problems. If your present line-up is logical for your requirements, these machines will fit into the picture and go on from there. If existing conditions call for improvement, a Vaughn Engineer can readily suggest a profitable realignment for you.

Call in the Vaughn man—and have him give you every detail on the most modern and profitable wire drawing machinery available to any manufacturer today!

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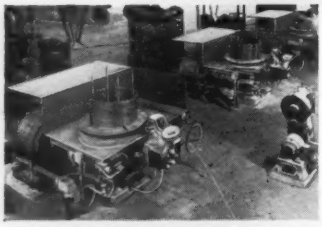
FOR WET OR DRY DRAWING OF
STEEL...COPPER...ALLOYS



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MOTOBLOC
HR MOTOBLOX
HI MOTOBLOX
HIV MOTOBLOX
HF CONE TYPE CONTINUOUS MACHINE
HIC CONE TYPE CONTINUOUS MACHINE
TAKE-UP FRAMES

•

MACHINES FOR COPPER, BRASS, BRONZE AND CERTAIN SPECIAL ALLOYS:

EXTRA HEAVY TANDEM CONTINUOUS MACHINE
NO. 1 CONTINUOUS MACHINE
NO. 2-A CONTINUOUS MACHINE
NO. 3-A CONTINUOUS MACHINE
HRW MOTOBLOX
HRH MOTOBLOX

•

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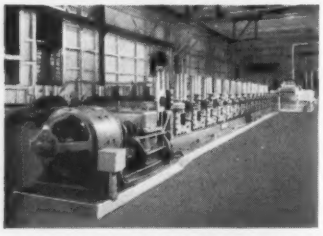
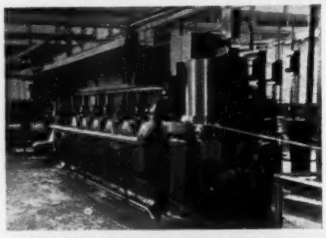
VAUGHN MOTOBLOX
Non-slip continuous machines for all sizes and grades of wire. Blocks, water-cooled and air-cooled.



VAUGHN TINNING FRAMES
For Steel Wire.



VAUGHN TANDEM COPPER WIRE DRAWING MACHINES
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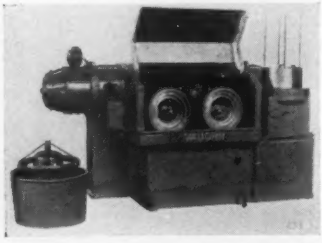

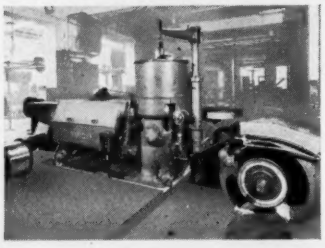

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these requirements are the tables of round bare wire, Tables 3 and 4 for the A (80 nickel 20 chromium) and the C (60 nickel 15 chromium) grades, respectively.

✦ ✦ ✦

THE wire drawer, in addition to his usual mechanical skill, must have sufficient electrical knowledge to operate resistance bridges, checking the quality of his machines. Visitors at the plant have remarked that the men seem to put in most of their time measuring and testing the output of their production units. Operations thus resemble those of plants making telephone equipment, where it is said that there are more inspectors than men on actual production.

✦ ✦ ✦

IT is rather obvious that mechanized control equipment is found all over the plant, and one expects and finds chemical, metallographic, physical, electrical, and research laboratories under the control of the Engineering Department, and an extensive test and inspection division through which all products pass. Testing equipment is continually checked against standard or master units and gauges are referred either to Johansen blocks or light wave micrometers whose measurements are independent of the individual operators.

✦ ✦ ✦

TESTING procedures follow specifications of the **American Society for Testing Materials** in which Committee B 4 on electric heating, electrical resistance, and electric furnace alloys has been active during the many years since its formation. Of specific interest might be the "Standard Test for Change of Resistance with Temperature of Metallic Materials for Electrical Heating," B 70-39, being the current modification of B 70-30, and the "Standard Accelerated Life Test for Metallic Materials for Electrical Heating," B 76-38, commonly referred to as the life test. In its present form, 0.0253 wire is subjected to alternating two-

"TOPHET C" WIRE
(Resistances and Weights) Specific Gravity 8.20
Resistivity 675 ohms per circular mil foot at 20°C. (68°F.)
Weight per cubic inch=.296 lbs.
***Factors for Determining Resistance at Various Temperatures**

Temperature °C	20	100	200	300	400	500	600	700	800	900	1000
Temperature °F	68	212	392	572	752	932	1112	1292	1472	1652	1832
Factor	1.00	1.007	1.019	1.032	1.047	1.054	1.055	1.058	1.063	1.070	1.080

*These figures will vary slightly with various sizes of wire due to rate of cooling.

B & S	Dia. in Inches	Ohms Per Ft. at 68°F (20°C)	Ohms Per Pound Bare Wire	Feet Per Pound Bare Wire	Weight Per 1000 Feet Bare Wire Pounds
1	.289	.008082	.03488	4.316	231.7
2	.258	.01014	.05466	5.391	185.5
3	.229	.01287	.08803	6.840	146.2
4	.204	.01622	.1398	8.621	116.0
5	.182	.02038	.2207	10.83	92.33
6	.162	.02572	.3516	13.67	73.16
7	.144	.03255	.5631	17.30	57.80
8	.128	04120	.9023	21.90	45.67
9	.114	.05194	1.434	27.60	36.23
10	.102	.06488	2.237	34.48	29.00
11	.091	.08151	3.516	43.14	23.18
12	.081	.1029	5.626	54.67	18.29
13	.072	.1302	9.010	69.20	14.45
14	.064	.1648	14.43	87.57	11.42
15	.057	.2078	22.94	110.4	9.054
16	.051	.2595	35.81	138.0	7.248
17	.045	.3333	59.06	177.2	5.642
18	.040	.4219	94.59	224.2	4.460
19	.036	.5208	144.2	276.8	3.613
20	.032	.6592	231.0	350.4	2.854
21	.0285	.8310	369.6	444.8	2.248
22	.0253	1.055	595.8	564.7	1.771
23	.0226	1.322	928.3	702.2	1.424
24	.0201	1.671	1,497.	896.1	1.116
25	.0179	2.107	2,360.	1,120.	.8931
26	.0159	2.670	3,789.	1,419.	.7047
27	.0142	3.348	5,956.	1,779.	.5620
28	.0126	4.251	9,603.	2,259.	.4427
29	.0113	5.286	15,097.	2,856.	.3501
30	.010	6.750	24,212.	3.587.	.2788
31	.0089	8.523	38,601.	4,529.	.2208
32	.008	10.55	59,133.	5,605.	.1784
33	.0071	13.39	95,297.	7,117.	.1405
34	.0063	17.00	153,714.	9,042.	.1106
35	.0056	21.52	246,167.	11,439.	.08742
36	.005	27.00	387,423.	14,349.	.06969
37	.0045	33.33	590,741.	17,724.	.05642
38	.004	42.19	945,984.	22,422.	.04460
39	.0035	55.10	1,614,871.	29,308.	.03412
40	.0031	70.24	2,624,799.	37,369.	.02676
	.00275	89.29	4,282,527.	47,962.	.02085
	.0025	108.0	6,210,432.	57,504.	.01739
	.00225	133.4	9,569,582.	71,736.	.01394
	.002	168.8	15,138,997.	89,686.	.01115
	.00175	220.6	25,860,938.	117,230.	.008530
	.0015	300.0	47,877,300.	159,591.	.006266
	.0014	344.4	63,030,710.	183,016.	.005464
	.0013	399.4	84,780,238.	212,269.	.004711
	.0012	468.7	116,766,293.	249,128.	.004014
	.0011	557.8	165,372,081.	296,472.	.003373
	.001	675.0	242,109,000.	358,680.	.002788

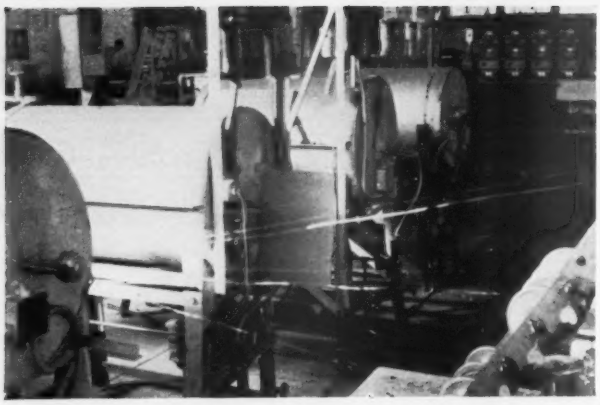


Fig. 16. Fine wire annealing. ✦ ✦ ✦ ✦

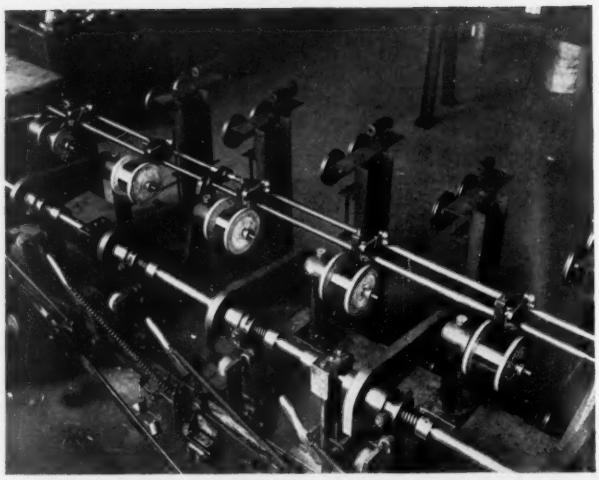


Fig. 17. Respooling. The final neat, compact, even-layered spooling is done on machines like this. Successive turns of wire on each spool must be laid down without "crossing", for crossed wire causes tangling when the wire is later run off the spool in the customer's plant. ✦

Fig. 18. Life Testing. Each lot of heater wire is subjected to the standard A.S.T.M. high temperature life test, in which a stressed specimen is electrically heated, in a glass-enclosed compartment, in 2-min. off the 2-min. on cycles until burn-out occurs. This photo shows a testing engineer reading the wire temperature with an optical pryometer. ✦

Fig. 19. Inspection. In the inspection department the electrical resistance and diameter of the wire on each spool are accurately measured and recorded on the label affixed to the spool. Resistance of very fine wire is measured with a Wheatstone bridge, and of heavier (lower resistance) wire with a Kelvin bridge for greater accuracy. Diameter and "roundness" are checked with a Zeiss indicating micrometer or the latest type of "light-wave" micrometer, both of which can be seen in this picture. ✦

minute periods of heating and cooling at temperatures of 2150°F. for the A grade and 2050°F. for the C type, the life being reported in hours to physical failure or 10 per cent increase in resistance, whichever occurs first. Conversion of accelerated life test values into service life indicates, for example, that the present day quality wires employed in electrical appliances such as toasters used thirty minutes a day and being turned on and off four times during that period, would last more than fifty years, or about 100,000 cycles of heating and cooling at the operating temperature of the toaster.

✦ ✦ ✦

ELECTRICAL resistance wire is precision material manufactured under the watchful combined activities of the chemist, the metallurgist, the physicist, the electrical and mechanical engineers, and whose quality is being augmented by coordinated research. Its industrial performance is of such high order that it has become the efficient, taken-for-granted factor in our daily lives.

✦ ✦ ✦

Make Your Plans Now To Attend
THE WIRE ASSOCIATION ANNUAL CONVENTION
THE NATIONAL METAL CONGRESS
CHICAGO, ILL. OCTOBER 23-27, 1939

Wire Solder---Its Manufacture And Uses

By Robert A. Gardiner,
President,
Gardiner Metal Company, Chicago, Illinois

The history, development and uses of wire solder. ✦ ✦ While made for centuries in some form or other, it is only in recent years that it has assumed an important part in industry. ✦ ✦ ✦ ✦ ✦

FEW people, even those in the industry, realize the part that wire solders play in making possible communication, transportation and sustenance. Will dwell later on these before the cart is placed too far ahead of the horse.

✦ ✦ ✦

WIRE Solders, as a general rule, come under the soft solder group, namely tin and lead alloys of various composition.

✦ ✦ ✦

ALTHOUGH we are told that the Greeks produced both tin and lead in 1500 B.C., just who and when solder of a tin and lead alloy was discovered is really unknown. It is logical, however, to expect that some resourceful Grecian through dire necessity made the discovery.

✦ ✦ ✦

GOING back to wire solder, records show that the first patents for extruding wire solder were taken out in England in the year 1797. The patents covered the extrusion of lead, tin or their alloys. The first extrusion machines were what we would now call clumsy tools, somewhat resembling hollow cylinders with a hole in one end and fitted with a piston, a lead or solder alloy was then inserted in the cylinder and heated just below its melting point. Pressure then was applied and the cylinder was actuated by a screw. Continued pressure on the ingot forced same to emerge from the hole in the bottom in the shape of a rod.

✦ ✦ ✦

LATER on someone thought of partially closing the orifice at the bottom of the cylinder by means of a rod, smaller, of course, than the hole, which was held in a fixed position. When pressure was applied to the ingot as before, the metal emerged in the form of a hollow tube. From this development not only lead and tin pipe resulted, but this same principle plus many refinements are now employed in the manufacture of self-fluxing wire solder in which the acid and rosin or special fluxes are incorporated.

R. A. GARDINER

Mr. R. A. Gardiner, now president of the Gardiner Metal Company, became connected, along with his father and three brothers, Harry J., William L., and Arthur Gardiner, when the company was formed in 1900. The company was incorporated under the laws of the State of Illinois in 1910. Following the death of the late James J. Gardiner, founder of the company, he became president. The company is actively engaged in the manufacture of all white metal alloys. His knowledge of the white metal field is far reaching owing to his extensive experience in all its divisions for the past forty years.

✦ ✦ ✦

THE use of power pressure for extruding cold metal dates back, records show, to the year 1870. Several years later the hydraulic press was developed to extrude wire solder in one strand and usually of a large diameter compared to those that are now in more or less general use. The later development was a multiple die inserted in the ram, which produces several strands of wire solder in one operation. Through this method, these days multiple dies are used for extruding solder in many gauges, some as small as 1/32". Hydraulic presses, of course, have their limitations, and therefore, manufacturers are limited in the range of gauges of wire solders for the finer gauge the greater pressure is required.

✦ ✦ ✦

THERE is another old method of manufacturing wire solder still being used by a few, and that is known as the wheel. In this method, solder is poured over a wheel through a small hole, usually of the gauge required; however, by this method uniformity and size is not possible.

✦ ✦ ✦

THE latest development, assuring uniformity in the manufacture of wire solders, which is very important, particularly where the solder is used on automatic machines, is that of first extruding the solder, and then sized through sizing dies similar to the manner in which copper and steel wires are made. The very latest de-

velopment in the wire solders is that of the flux-filled type. The same extrusion equipment is as a general rule used; however, the speed at which the solder can be extruded is limited for the reason that the tube must weld itself in a seamless manner. By placing solder of this type on the market, owing to the simplicity with which it can be used, even the layman has been brought into the potential field of users.

✦ ✦ ✦

COPPER and steel wire can be sized considerably faster because of their increased tensile strength.

✦ ✦ ✦

WHEN it is brought to mind that soft solder wire can be broken with no more effort than it takes to break a piece of fine silk thread, it will be easier to apprehend some of the difficulties encountered in its processing.

✦ ✦ ✦

IT will perhaps be asked why all the great care has been used to produce a perfect wire solder. In days gone by, speed in production was not thought of, today it is the foremost item. Further, automatic machines have been developed for soldering, that must have a perfect wire solder used in their connection or they fail.

✦ ✦ ✦

LET us analyze for a moment some of the uses to which wire solder is put. Platinum wires from as fine as 1/60 of a human hair up to the largest copper wires used in electrical work are soldered. The larger conduits are, of course, soldered with bar solder or dipped in a bath of solder, but the finer wires must necessarily be soldered with a fine wire solder. Under most ordinary conditions, solder in most any form will answer the purpose to join two pieces of metal. For example; a radio could be assembled by using a bar of solder and an ordinary soldering iron, but for production purposes this would not work as it would be too clumsy and slow.

✦ ✦ ✦

SOME of the newer plumbing installed in buildings today is of the sweat solder joint type rather than the conventional thread. Here again wire solder comes forward as being the most practical. In fact, we might even say that solder in the wire form was in a way partly responsible for this type of plumbing.

✦ ✦ ✦

FOR example; in the canning industry, condensed milk in particular. In days gone by, 50 cans per minute were filled and soldered. Today this has been increased to 275 per minute. With the coarse crude wire solder originally made 12-20 oz. per thousand cans was consumed. Today this consumption has been reduced to 3-3½ oz. per thousand cans with approximately 1/10% imperfect seals. This is only one of the many such operations where automatic soldering has demanded a perfect wire solder.

✦ ✦ ✦

IN the electrical industry where very fine articles are made, fine gauge wire solder has played an important part in helping to increase perfect production.

✦ ✦ ✦

CONSUMERS of solder in wire form have today become more and more conscious of the necessity of securing the exact wire size for each operation. The finer the wire the less solder consumed per joint and the less heat is required to melt it, thus faster and more accurate production. Solder can be applied in abundance and while the purpose of joining two pieces of metal together is accomplished, a very clumsy and sloppy result is obtained. This is both costly and presents poor workmanship.

✦ ✦ ✦

ANOTHER use to which wire solder is put is the solder gun. While this instrument is still in its infancy, many uses have already been found for it. Originally it was designed for work on automobile bodies; namely for filling in dents and cracks where paddling or wiping would be too slow. At the present, it is being used in the manufacture of modernistic furniture. Solder is sprayed into grooves made in the wood and then flattened presenting an inlaid appearance.

✦ ✦ ✦

IT would be impossible to enumerate all the uses to which wire solders are put. Wire solder is used in the manufacture of telephone instruments, which include receivers, transmitters, switchboards as well as lines. This is also true in telegraphic instruments. In radio and wireless, numerous uses for wire solders have developed in the manufacture of the many units employed in the manufacture of radio sets and transmitting equipment. As for transportation, wire solder plays an important part in electrical, air-conditioning and other equipment used in railroad trains whether they be powered by coal, oil or electricity. Millions of automobiles travelling the road daily, consist of many units, whose functions depend on wire solders, such as ignition, lighting and heating systems, as well as radio. Possibly in aeronautics, wire solders play the most important part in transportation. They are used extensively in the manufacture and assembling of delicate instruments required by aeroplanes, including radio and the stations that provide for open lanes for pilots, and serve as a means of holding a direct contact at all times.

✦ ✦ ✦

IN connection with human lives, wire solder plays a most important part in the manufacturing of X-ray equipment.

✦ ✦ ✦

IN the foregoing paper, we have tried to point out some of the uses of wire solder and give you some of its history. In conclusion, may we say that while wire solder has been made for centuries in some form or another, it was not until recent years that it has played such an important part in all fields of industry. May we recall to mind it is conventionally made in sizes from ¼" dia. to 1/32" dia., in solid wire, as well as cored solders incorporating most all of the common fluxes in all alloys from pure tin down to pure lead.

Submerged Heat by Submerged Combustion

By Walter G. See,
Sales and Service Manager,
Submerged Combustion Co. of America, Hammond, Ind.

By the use of the Submerged Combustion process the pickling of wire or rods in coil form is accomplished at a rate difficult to achieve with other processes. An outline of the method and the operating costs results is presented herein. ✦ ✦ ✦

Introductory

SUBMERGED combustion is a development which extends back to 1887 when Brunler developed the first submerged combustion burner. This burner was ignited by hand and then lowered into the vat to be heated. When the vat had reached its desired temperature, the burner was turned off by hand. When heat was again needed in the vat, the burner was removed from the liquid, ignited and again submerged. The idea for a completely automatic submerged combustion burner was conceived by a man familiar with the pickling practice in steel plants. It was realized that only the simplest form of control would be successful.

✦ ✦ ✦

Advantages of Submerged Combustion

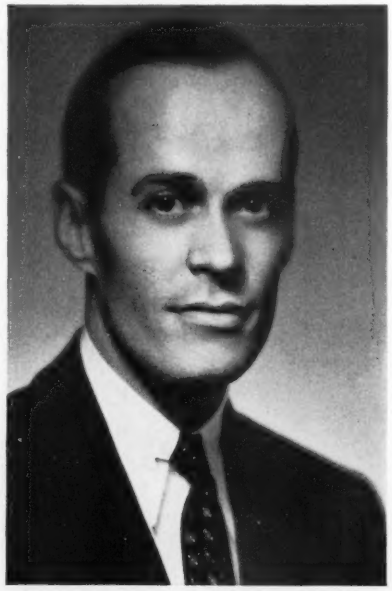
SUBMERGED combustion can be used to advantage in many applications of solution heating. It is particularly adaptable to rapid distillation and concentration of liquids. It may be used to heat and agitate many types of cleaning solutions.

✦ ✦ ✦

ONE of the most practical applications for submerged combustion is the pickling of wire or rods in coil form. As you all know, the rate of scale removal from steel is increased by agitation. This may be accomplished either by moving the work within the solution or moving the solution about the work.

Wire

BY the use of submerged combustion units the pickling solution, generally dilute sulphuric acid, is agitated and moved about the vat at a rate which would be extremely difficult to achieve mechanically. As a result, the average pickling time on various grades of steel will run from 30 to 60 per cent of former practice if the operating temperature is held the same as it was with steam.



WALTER GEORGE SEE

Educated at Shady Side Academy, Pittsburgh, Pa., and the Carnegie Institute of Technology in Commercial Engineering. From there entered the employment of the LaSalle Steel Company in the Pickling Department and from 1934 to 1937 was engaged in development work on submerged combustion burners. From 1937 to the present time, engaged in development, installation, sales and service work as Sales and Service Manager of the Submerged Combustion Company of America.

✦ ✦ ✦

WHEN it is desirable to operate the pickle tub at a lower temperature, the same rate of production obtained at approximately 190 degrees Fahrenheit with steam can be maintained with a temperature of 160 degrees Fahrenheit using submerged combustion. This lower temperature is naturally more economical in several ways.

✦ ✦ ✦

THE agitation also serves to keep the temperature extremely uniform throughout practically any size tank. In fact, temperature differences are so small that they cannot be measured by ordinary means.

✦ ✦ ✦

Operating Costs

IN an article "Essentials of Good Pickling Practice" by P. R. Russell of the Republic Steel Corporation, the following illustration of excessive operation cost due to high temperature in the pickling vats is clearly brought out. In this particular case the pickling house for this wire mill was inadequate.

✦ ✦ ✦

QUOTING from this article, "To fill the 'bake oven' of this particular mill with a sufficient

number of rods to keep the rod blocks supplied with pickled, limed and dried rods, a pickling cycle of 12-15 minutes had to be maintained. As there were only four two-pin pickle tubs, an excessive temperature of around 190-195 degrees Fahrenheit and an acidity of 5-7% was necessary. If two more pickle tubs had been added to this pickle house and the proper use of a good inhibitor incorporated in the practice, operating temperatures could have been reduced to 155-160 degrees Fahrenheit and the pickling cycle increased to 20-25 minutes. The net result of this added capacity and the consequent change and improvement in practice would be a saving of approximately ten pounds of acid per ton of rods pickled.

✦ ✦ ✦

"THE question naturally arises, would the expenditure for added equipment be justified? A brief consideration of the following data will prove conclusively that such added equipment would prove economical.

✦ ✦ ✦

"THE production of pickled rods required in the mill under consideration runs about 6,000 tons per month. Let us assume that the cost of acid is about $12.00 per ton. The net monthly saving effected by the additional equipment and the improved practice would be about $360.00 per month — a saving which would look good on the cost sheets of any mill.

✦ ✦ ✦

"THERE are also more intangible savings. These are, mainly: added life of equipment, reduction of steam losses and practically the elimination of unnecessary metal loss. In addition to these, there will be a large saving made possible by more efficient labor due to improved operating conditions."

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NOW the conclusion arrived at by Mr. Russell was logical and correct from the standpoint of steam heat in the vats. Using submerged combustion, however, the conclusion would be quite different. It would then be as follows: Equip the present four acid tanks with submerged combustion burners. Drop the working temperature to the same level namely, 155 to 160 degrees Fahrenheit and maintain the original time cycle of 15 minutes. Due to the effect of direct firing the acid saving would be the original ten pounds per ton plus approximately 40% of added acid during the life of the solution. Added to the intangible savings would be no steam loss as none would be required.

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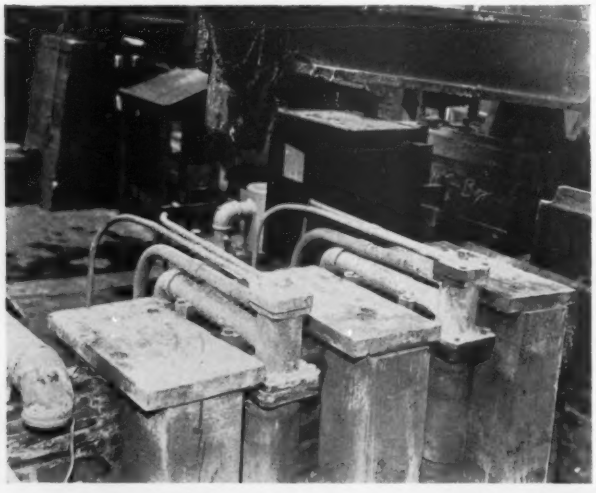
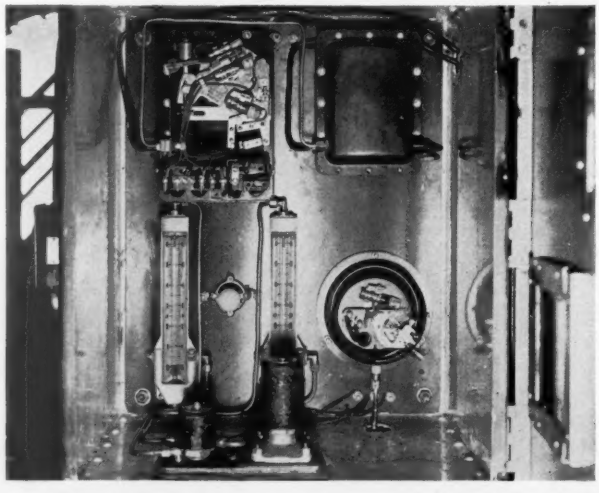
LET us look at a case where these units are now in operation:—

POUNDS per man hour are given in place of the total production figures because of the extreme fluctuation of business in the past ten years. In this particular plant there are two coil tanks—one holding two pins and one holding five pins of coils. In 1928, '29 and '30 pickling was done using open steam jets. The average pounds per man hour during this three-year period was 1916.0. In 1931 the first burner was installed experimentally. During the next four-year period the burner was running on an average of 50% of the time. During this four-year period with only the two-pin tank equipped with a submerged combustion burner and that burner operating only 50% of the time the pounds per man hour rose from the 1916.0 to 3129.9. This shows a decided increase. The following year, 1935, was the first year a submerged combustion burner operated on a scale which made it commercially feasible. In this year the burner was kept running every production day of the year. Again the pounds per man hour went up from 3129.9 to 4022.8. This showed an increase over the 1928, '29 and '30 period of 209.9% and an increase of 128.5% over the 1931 through 1934 period. In 1936 both wire tanks were equipped with burners. Again the pounds per man hour went up. This time, however, the rise was smaller due to the inability of the men and



Double Installation of Burners in a Large Vat.



The Control Cabinet.

auxiliary equipment to handle the steel. The new pounds per man hour figure rose to 4287.2 for the period 1936 through 1938. The figures available for the three years before 1931 when steam alone was used show 1429.9 pounds per man hour to be the lowest attained in that period while the highest figure was 2657.8 pounds per man hour. Compare this with the highest figure of 1938 which was 6253.9 using submerged combustion. This is 4824 pounds per man hour above the low figure with steam and 3596 pounds or 235.3% above the highest steam figure in that period.

✦ ✦ ✦

FOR the sake of simpler comparison let us level off these high and low figures and use an average figure for the above periods. The average pounds per man hour for 1928, '29 and '30 was 1916. During 1936, '37 and '38 when the burners were used constantly the pounds per man hour averaged 4287.2. This is an increase of 223.7% and was obtained with no additional equipment except submerged combustion burners in each vat.

✦ ✦ ✦

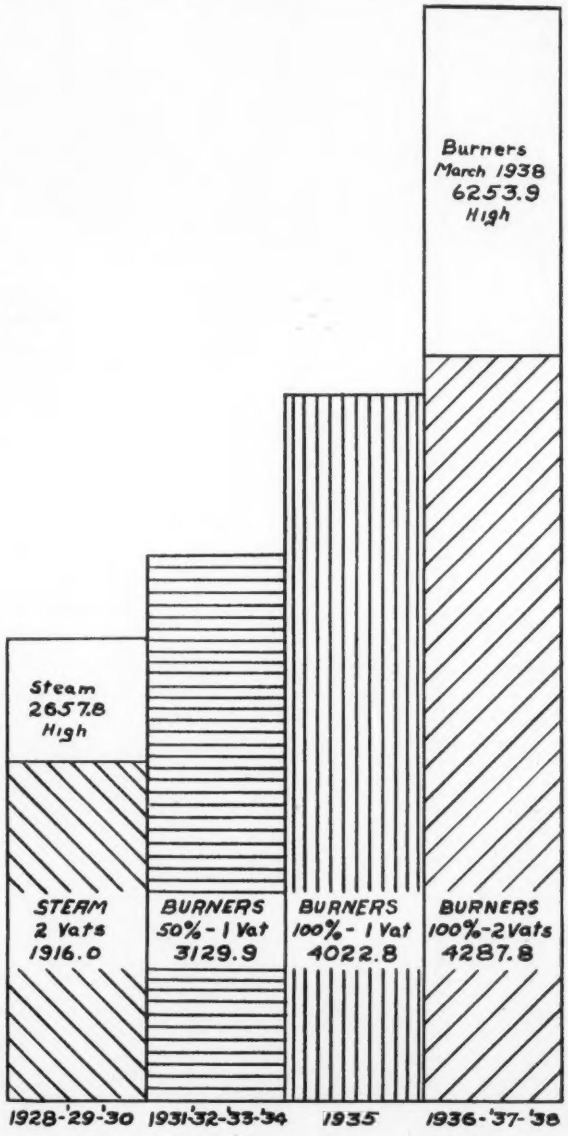
THE above figures were obtained from a plant which pickles wire from #5 gauge to 13/16" diameter and is located in the Calumet Region.

✦ ✦ ✦

A SECOND advantage of submerged combustion for pickling is its flexibility. Each pickle tank in a plant can operate as an individual and efficient unit. It is not dependent upon a central generating system whose efficiency falls off at anything under a full load rating. This is particularly important in small plants where the boiler is used for nothing save heating the pickling tanks and the plant itself in winter. One plant operating under the above conditions found it advantageous to discontinue operating the boiler, install unit heaters for heating the plant, and use submerged combustion units to heat its pickle tanks. The lime tanks were equipped with immersion burners.

✦ ✦ ✦

ANOTHER important advantage is the constant temperature mentioned before. This prevents excessive heat consumption and gives a more uniform product of higher quality. In one company rejections of wire rod coils were reduced from approximately four to six loads per day to about one load every two weeks due to the advantages of the constant temperature and extreme agitation furnished by submerged combustion.



Pounds per Man Hour Comparison
of
STEAM VS SUBMERGED COMBUSTION

✦ ✦ ✦

WHEN open steam jets are used to heat pickling tanks, the steam condenses in the solution. This condensate dilutes the solution and raises the working level of the vat until it becomes necessary to drain off part of the solution to maintain a proper working level. A certain percentage of acid is lost in this operation and then, too, acid must be added to the diluted solution in the tank in order to bring it up to the proper strength.

✦ ✦ ✦

HOWEVER, when submerged combustion equipment is used, the direct firing in the solution evaporates the water, increases the acid concentration and lowers the working level of the solution. Only water need be added to maintain the correct working level of the tub. The only acid lost is that which goes into chemical reaction with the steel and the small amount lost in dripping or splashing when a load is removed from the tub. This evaporative effect makes possible a savings of from 25 to 50 per cent of the acid added during the life of the solution.

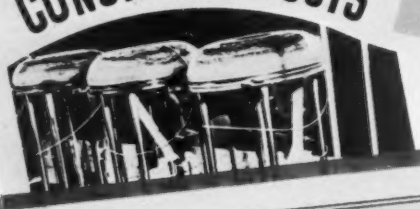
✦ ✦ ✦

IN conclusion let me summarize the savings which can be effected by the use

(*Please turn to Page 615*)

...and they a

THE TREASURER CONSIDERS COSTS



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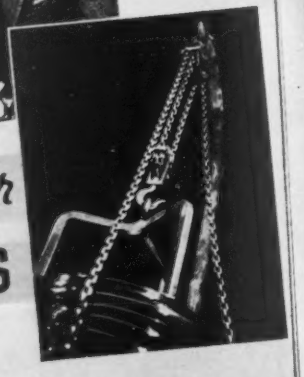

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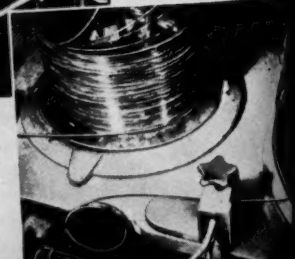

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so are the reasons behind th
as the president is careful
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good dividends through ✓
er production and ✓all
savings in costs. Power b
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and spoilage almost co
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is continuous. More orders
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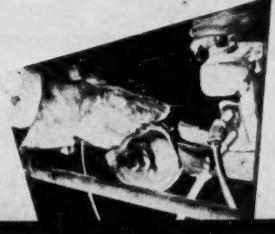

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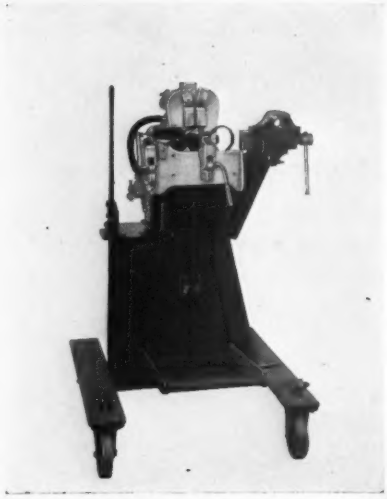

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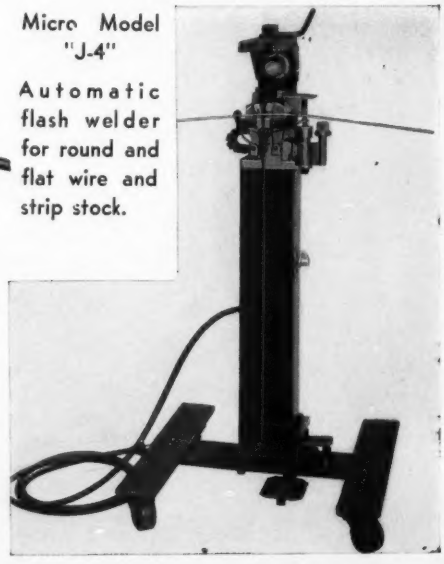

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The Engineering of Continuous Strand Equipment

By Rodman R. Tatnall,
Metallurgical Engineer, Morgan Works,
Wickwire Spencer Steel Co., Worcester, Mass.

A great many wire making processes lend themselves readily to the method of treating in continuous strands, and many cannot be accomplished except by this method. However, too often design, operation, and expectations of such equipment result only from a growth of experience, and the economic efficiency falls short of the possible maximum. In this paper, it is shown that any type of strand processing has a definite maximum output, depending on the duties required of the operator, and correct engineering gives a close approach to this maximum. Design of equipment, as well as plan of operation, should follow certain definite rules in order to insure the maximum of quality production. ✦ ✦ ✦

WIRE making processes such as patenting, tempering, galvanizing, even wire drawing itself, cannot be accomplished without the treatment of the wire in continuous strands. Many other treatments are advantageously carried out in this manner, either at lower cost, or with greater uniformity, compared with other methods. Many factors enter into the cost of a process, but the most important of these is the direct labor cost, which is, of course, dependent on the quantity of material produced. A standard plan for operation in regard to wire speeds and number of strands is necessary, not only to control quality, but to control standard costs, and it is the engineering behind the establishment of such standards that is discussed in this paper.

✦ ✦ ✦

Performance of Strand Equipment

FOR the purposes of standard costs, the production performance of a strand unit is calculated from three factors, wire size, speed of wire through the unit, and the number of strands run. Wire size determines the number of pounds per foot of wire, and is the only one of the three which is not subject to mill variation. Both speed and number of strands may result from cut and try determinations, and something workable for the particular equipment in question is set up. Thus the operating plan may be the result of a somewhat uneven growth of experience, and it is possible that such a plan does not always utilize the full capacity of the equipment, or that some details of a given equipment prevent the attainment of the potential capacity provided in other details.

RODMAN R. TATNALL

Born in New Rochelle, N. Y., in 1906. Educated at Worcester Polytechnic Institute. First employment one year in Development Dept. of Waltham Watch Co. In 1928, joined Wickwire Spencer Steel Co. in spring production dept. In 1930, was promoted to position of Metallurgical Engineer, and since then has been in charge of experiment and research on spring and spring materials. Member of Wire Association and American Society for Metals.

✦ ✦ ✦

K. B. LEWIS, in a paper published in the Iron Age in 1925, describes the work of preparation and disposal in wire drawing as "chores". The same term applies to any strand treatment of wire, since wire drawing is itself a strand treatment. He develops the theory that the only factors entering into the efficiency of wire drawing equipment from a production standpoint are the weight of the bundle of wire, and the chore time. The present author arrived at the same conclusion with respect to any strand processing through a line of reasoning which will be demonstrated in the following paragraphs.

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Derivation of Performance Factors

OF the three factors used in production calculations, wire size enters only through a physical relation to weight which is entirely independent of equipment. Wire speed and number of strands have definite relations to other characteristics of the equipment, and are effected by various elements in design.

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THE **weight per foot** of any wire size depends on the volume of metal and the nature of the material. Since the volume of a foot of any size of wire varies as the square of the diameter, the weight

per foot of any size (of steel wire) is expressed

$$\text{Weight per foot} = 2.67 \times (\text{wire dia.})^2 \quad (1)$$

Feet per pound is simply the reciprocal of the above relation, and may be written

$$\text{Feet per pound} = \frac{.3749}{(\text{wire dia.})^2} \quad (2)$$

✦ ✦ ✦

THE relations governing wire speed can be set up mathematically, independent of "past practice", or "present standards", and this line of reasoning provides a method of checking the performance of existing equipment, or a basis for the design of future installations. The several secondary factors are here defined and clarified.

✦ ✦ ✦

SPEED of wire through the unit in feet per minute is dependent primarily on the necessary time for the completion of the process, together with the active operating length of the unit. The required time depends on the size of the wire, and the nature of the treatment, the exact relations tracing back to the theories of heat treatment, as in patenting, or chemical action, as in plating or pickling. However, a general expression which covers any variation of time with wire size is

$$\text{Treating time} = \text{Constant} \times (\text{wire dia.})^n \quad (3)$$

in which 'n' is an exponent the value of which is determined by the process, and the constant is a value of time, also determined by the process, which in reality is a time for the treatment of unit diameter (theoretically, 1" diameter wire). The factor treating time, in Eq. 3 above, can be combined with length of unit to give wire speed. Thus,

$$\text{Speed of wire} = \frac{\text{Length of Unit}}{\text{Time per 1"} \times (\text{wire dia.})^n} \quad (4)$$

✦ ✦ ✦

IN order to establish the third production factor, number of strands, a further set of conditions must be studied, in which the main influences are the time required to run off a complete bundle of wire through the unit, and the time required for chores.

✦ ✦ ✦

RUNNING time is the relation between the number of feet of wire in a bundle and the speed at which the wire passes through the unit. The number of feet in the bundle is the feet per pound (Eq. 2) times the bundle weight, or,

$$\text{Feet per bundle} = \frac{.3749 \times \text{Bdle. Wt.}}{(\text{wire dia.})^2} \quad (5)$$

The combination of wire speed (Eq. 4) and feet per bundle (Eq. 5) then gives the running time, thus,

$$\text{Running Time} = \frac{.3749 \times \text{Bdle. Wt.} \times \text{Time per 1"}}{\text{Unit Length} \times (\text{wire dia.})^{2-n}} \quad (6)$$

✦ ✦ ✦

CHORE time involves many factors, some definitely measurable, and some intangible. The time required to weld ends, cut band wires, or strip the bundle from the take-up is measurable and can readily be found by time-study. Other factors, such as the human element, or accidental interference with the moving wires cannot be measured, but nevertheless must have some allowance. The human element must cover the knowledge, ability, or willingness of one man to do his work more efficiently than another. In addition, some unavoidable time lost from actual duties must be allowed.

✦ ✦ ✦

IN any event, either careful study, or the application of experience will indicate a maximum reasonable non-productive time, to be added to the measured time required for duties. This total time, classed in this discussion as chore time, will vary widely depending on the nature of the process, the exact duties required, and the auxiliary equipment provided to assist these duties. When more than one man operates a unit, the chore time, as it is applied here, is not the total time expended on one bundle, but instead is the time spent by one man, the controlling time being the longer one, in case the men do not have exactly equal duties.

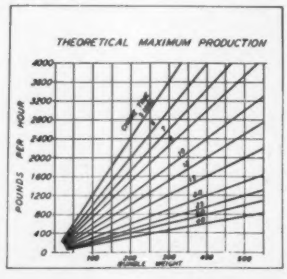

Fig. 1.

✦ ✦ ✦

NUMBER of strands is determined on the basis that a man can perform the chore services a certain number of times while a complete bundle is running through the unit. It is thus possible to take care of this number of strands running through the equipment before the one first started needs attention again, even though the complete cycle of duties is not carried out continuously on any one bundle. If a bundle or a wire needs attention while it is running, a time allowance is counted into the total chore time. On this basis, number of strands is established by dividing the running time by the chore time, and combination of previous equations gives,

$$\text{No. of Strands} = \frac{.3749 \times \text{Bdle. Wt.} \times \text{Time per 1"}}{\text{Chore time} \times \text{Unit Len.} \times (\text{wire dia})^{2-n}} \quad (7)$$

✦ ✦ ✦

IN Equations (1), (4), and (7) the three factors from which production is found are shown in their elementary components. By multiplying these together production is determined. Multiplying these equations algebraically, and making cancellations, the following expression is finally obtained.

$$\text{Production (\#/hr.)} = \frac{60 \times \text{Bundle Weight}}{\text{Chore Time}} \quad (8)$$

✦ ✦ ✦

THE production given by the above expression is the maximum theoretically possible. Obviously it is dependent only on the weight of a bundle and the time required for chores. There is, however, a deeper meaning which can be drawn from the factors in this expression, or rather absent

from it. After being carefully set up in the previous steps, none of the fundamental factors appear in the final formula for theoretical production. This means that regardless of length of unit, speed of wire, number of strands, etc., the possible production of a unit depends only on the size of the bundle and the time required to work on it.

✦ ✦ ✦

EACH of the foregoing equations has its usefulness however, in determining the correct operating plan for a given unit, or working out comparisons between various designs, since these expressions give the relations which must be followed accurately if the process is to result in high quality and maximum efficiency.

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FOR reference purposes, a graph of Equation 8 above is shown in Figure 1, from which the theoretical production for any reasonable combination of bundle weight and chore time can be readily found.

✦ ✦ ✦

Examples of Strand Equipment

APPLICATION of the foregoing reasoning and the use of the equations developed may give a valuable analysis of some specific equipment. To illustrate, two typical units have been taken for consideration, Unit A handling sizes from ½" to #7, and Unit B sizes from #7 to #14, both giving the same treatment, which involves heating of the wire. Figures 2A and 3A show the production graphs of these units, according to practices which were undoubtedy the result of a condensing of experience over many years in the past.

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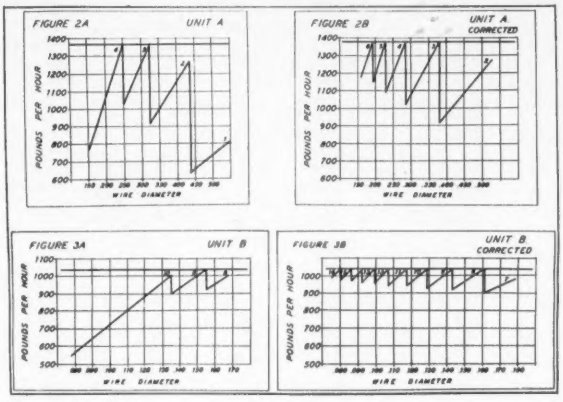

Figures 2 and 3.

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FOR the purpose of testing efficiency, Formula 8 can be applied. Bundle weight is 275#, and a reasonable chore time for Unit A is 12.0 minutes, and for Unit B, 16.0 minutes, these figures being found from time studies and other considerations which will be discussed later. These figures then give a maximum theoretical output for Unit A of 1375 lbs/hr, these values being shown in the production graphs by the horizontal lines of Figures 2A and 3A respectively.

✦ ✦ ✦

THE small figures in these graphs are the number of strands run, and the effect of changing number of strands is brought out clearly by this method of presentation. In Figures 2B and 3B, accompanying these graphs, the production of operating plans for these same units based on full analysis is shown. This complete analysis makes use of the various relations previously discussed, and the manner in which they are applied will now be considered.

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THE first step may well be the study of number of strands from the engineering point of view. This can be done by finding feet per bundle and running time for appropriate sizes, and from these, together with the given number of strands, a time available for chores. Results for a few selected sizes are shown in Table 1, in which the number of strands comes from the operation plan, while feet per bundle and running time are found by Eqs. 5 and 6 respectively. The time available for chores is found by dividing running time by the number of strands.

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THIS is simply a determination of how much time can be spent on one bundle, when this plan is followed. The value found is the key to the efficiency of the unit, since in every case, where production is low, the available time is more than that actually required to do the work. If it should be less than the time required for work, the time study or other basis of chore time is inaccurate.

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IN Table I, the lowest time available for chores is, for

Table 1.
ANALYSIS OF PRODUCTION FACTORS

Wire Size, Inches	Number of Strands	Feet per Bundle	Running Time, minutes	Time Available Chores
		Unit. A.		
.500	1	412	22.4	22.4
.437	1	539	25.9	25.9
.406	2	625	28.0	14.0
.344	2	871	33.7	16.8
.312	3	1058	37.5	12.5
.250	3	1648	48.3	16.1
.244	4	1730	49.5	12.4
.177	4	3290	72.6	18.1
		Unit B.		
.162	8	3930	136.0	17.0
.148	9	4700	150.0	16.6
.135	9	5655	164.0	18.2
.120	10	7160	186.5	18.6
.080	10	16100	290.0	29.0

Unit A, 12.4 minutes and for Unit B, 16.6 minutes. Other sizes of wire show a greater time available, but this added amount is not necessary, since the same duties can be performed in less time on wire only slightly different in size. Consideration of the time available, in conjunction with chore time, can readily show whether a low production is the result of an unavoidable penalty, which will be explained later, or is a true inefficiency of operation.

✦ ✦ ✦

IN the case of .500″ size on Unit A, 22.4 minutes are available for chores, running one strand. However, two strands will require 24.8 minutes for the chores on two bundles, and hence two strands cannot be kept running. On the other hand, size .437″ shows an available time of 25.9 minutes, and two strands can be run where only one is given on the operation plan. The same effect is apparent for .138″ size on Unit B, and both are true inefficiencies of operation.

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ANOTHER, very important, production penalty incurred on these two units is well illustrated in Figure 3A, in which the production decreases uniformly for sizes under .128″ because all these sizes are run with the same number of strands due to the fact that the take-up has only 10 blocks. In Table 1, this is apparent in the increase of time available as the size decreases. The same comment also holds for Unit A, except that the effect is not so great.

✦ ✦ ✦

THE remaining factor, wire speed, should also be checked through the fundamental elements which determine treating time. This investigation can be carried out by means of calculations from given wire speeds, tracing back through the various elements. However, for an accurate determination of the correctness not only of the exponent in the treating time relation, but also of the constant, the metallurgist must be consulted. His knowledge of the purposes of various treatments, together with the reactions of the materials, alone can give the correct fundamentals for the treating time relation.

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Corrections in Design and Operation

WITH the discrepancy in output evidenced in Figures 2A and 3A, it is desirable that both the design and operating plans of these units be corrected. Time study and careful consideration of other elements in chore time can give a reliable value for this factor, and from the metallurgist the correct elements of the time factor are obtained. Operating plans can then be established by calculation which will provide treatment according to the laws necessary for quality production.

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ACHORE time of 12 minutes for Unit A, and 16 minutes for Unit B may be taken as reasonable, not only from consideration of the last column of Table 1, but also from time studies, and other study of the work involved. Further, for the purposes of illustration, a constant of 4 minutes per 1″ diameter may be chosen as reasonably correct. New calculations may be made, using the foregoing elementary relations, with the results shown in Table 2.

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IT may be noted that these figures are found from a treating time based on an exponent $n = 1$ in Eq. 3. This value may or may not be strictly accurate, but is fairly close for the treatment involved, and was used for the sake of simplicity in the illustration.

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A PRODUCTION penalty is illustrated by the figures of Table 2, in which a fractional part of a strand is purposely shown in all the calculations. If this fraction is retained in figuring production, the same value is obtained for all sizes, a value equal to that found by the use of Equation 8. This is shown in the table as theoretical production. However, since it is actually impossible to run a fraction of a strand, true production must be figured from the next smaller whole number, for example, 2 instead of 2.29 as shown in the table. This loss in production is the unavoidable penalty referred to previously,

Table 2.
CORRECTED OPERATING SCHEDULE

Wire Size, Inches	Wire Speed, Ft./min.	Running Time, Minutes	No. of Strands	Production, #/hr. Theoret.	Production, #/hr. Actual
Unit A. Chore time 12 minutes, Bundle weight 275#					
.500	15.0	27.5	2.29	1375	1200
.406	18.5	33.7	2.81	1377	978
.375	20.0	36.6	3.05	1378	1356
.312	24.0	44.1	3.68	1375	1123
.281	26.7	48.8	4.06	1378	1355
.244	30.7	56.3	4.68	1375	1172
.225	33.3	61.1	5.09	1376	1351
.192	39.0	71.6	5.96	1374	1153
.177	42.3	77.7	6.47	1375	1275
Unit B. Chore time 16 minutes, Bundle weight 275#.					
.162	30.9	127.3	7.96	1032	906
.148	33.8	139.2	8.70	1031	949
.135	37.0	153.0	9.56	1032	971
.120	41.6	172.3	10.77	1032	960
.105	47.6	196.5	12.28	1032	1009
.091	54.9	226.5	14.16	1031	1020
.080	62.4	257.7	16.10	1031	1026

which is characteristic of this type of equipment.

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THE actual production given in Table 2 has been plotted to give Figures 2B and 3B for comparison with Figures 2A and 3A respectively.

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IT is significant that Unit A should be equipped to run 6 strands instead of 4, and that Unit B should be able to handle 16 instead of 10. This change does not require any other change in the unit, with the possible exception of width. However, it does mean that the operator will have more ground to cover on these sizes. He will have to perform the same cycle of chores a greater number of times, but, as a rule, much of the work is easier to do on the finer sizes to which the larger number of strands applies.

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ANOTHER point in the correction of this equipment is the fact that now, for .500″ size, two strands can be run. The low point of production is now at .380″ size, but it is not as low as the former low point. The corrections mentioned here have increased the mean production over the whole range of sizes from 1020 #/hr for Unit A to 1215 #/hr, approximately 20%, and for Unit B, from 900 to 980 #/hr, or 9%. The low points have been raised an even greater amount, 50% in the case of Unit A, and nearly doubled for Unit B.

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Achievement of Maximum Production

A DISCUSSION of the achievement of the theoretical maximum in performance deals with certain intangibles which may interfere. The human element has already been mentioned, and this can be compensated by the proper selection of chore time so that the goal is not too high. The attraction of added earnings may then lead to increased productions with the better workmen. A second influence is the unfortunate fact that bundle weights are never exactly to standard, which interferes somewhat with operation according to mathematical plan. However, a good man, by looking ahead, can anticipate details and avoid conflicts. Where there are several men working, or more than one unit operating, a little help at the right moment, given back and forth, prevents any loss in production. In addition, if one strand is lost, it can usually be started again with the next runout with comparatively small loss of production. A third factor is that of trouble with the moving wire, such as snarls in the coil, or breakage for one reason or another. These things must be allowed for to some degree in the chore time. Broken strands are of course started again at the first opportunity, lowering the actual production loss.

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IT may have been inferred from the previous discussion that the starting of production on the unit is planned so that run-outs are spaced with equal time intervals between. If such an arrangement is followed, many of the conflicts, as well as variable bundle weights, will not be so likely to interfere with production. However, in starting bundles with an equal time interval between, the number of strands actually running during the first period of time equal to the running time is only half the full number, and hence, the production for this period of time is only half. Similarly, when the unit is stopped, at the end of the turn or the end of the week as the case may be, the production will be only one half, for a similar period. If the starting and stopping of the unit occurs all in one turn, the production loss will be a large percentage. If the unit runs continuously through a week, the loss is negligible.

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ON the other hand, if all the strands are started together, production is at once at its full rate. In this case, the only thing which can prevent conflicts, that is, several run-outs at once, or duties in two different places at the same time, is the variable bundle weights. Many of the chore duties can be done ahead of time, so that the actual change of bundles can be accomplished without other things to interfere. Many details of the chore duties do not have to be done on the minute, and thus some leeway is allowed the operator to plan his activities so as to be where he is needed at the right time. Observation of various units in operation leads to the opinion that full production can be obtained with operation on this basis, if the operator knows his job well enough, or has a little help at times.

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Notes on Equipment Design

SOME general remarks on the design of this type of equipment are pertinent at this point, these being in the way of a general engineering summary.

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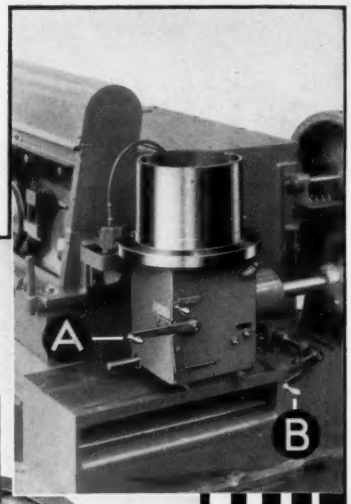
IT is apparent from the graphs that any particular unit length gives the maximum of production only for a certain few sizes, due to the penalty of fractional strands. Calculations for a unit of different length will give exactly the same type of production graph, except that the peaks of production will fall on other sizes. Unit lengths could be found such that maximum production might be obtained on any given size, but unfortunately such an adjustment cannot affect more than one in a series of sizes such as the standard guage numbers. Since a practical mill installation must handle a wide range of sizes, there is no way to overcome the penalty.

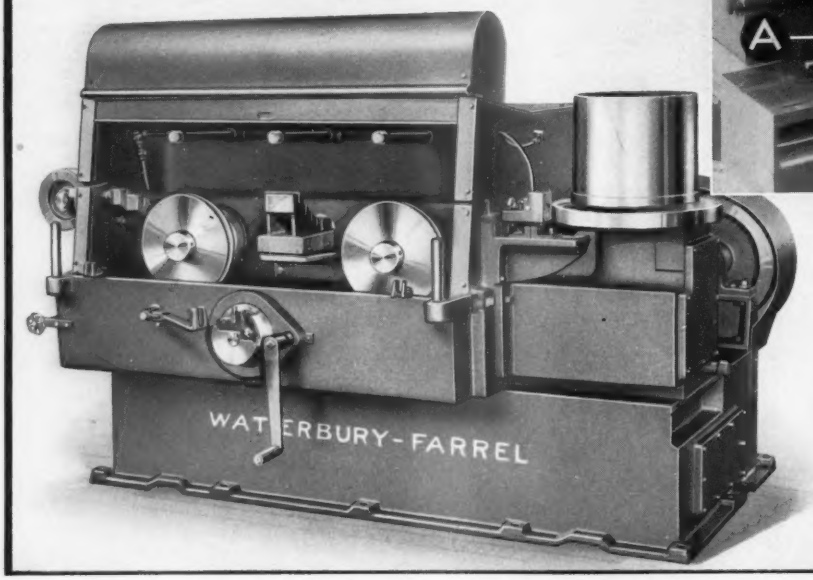
✦ ✦ ✦

IT may have been noticed that the amount of this strand penalty is greater in Unit A than in Unit B. In Figure 2B, the low point of production is $\frac{2}{3}$ of the maximum, while in Figure 3B, the low point is $\frac{7}{8}$ of the maximum. This is due to the percentage effect of changing 1 strand out of 3 in one case, and I strand out of 8 in the other. The swing in production in the whole graph is less for Unit B than for Unit A, which leads to the conclusion this type of penalty is less for a unit run-

(*Please turn to Page 609*)

WIRE DRAWING MACHINES





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The Brazing of Copper

By L. L. Wyman,
Research Engineer,
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The brazing of copper, in order to obtain a continuity of rod, etc., or in the fabrication of equipment, must meet definite physical and electrical requirements. Experience and experiment have shown that certain standards as to the type and size of joint to be used have been established and these are discussed in detail. ✦ ✦ ✦ ✦ ✦ ✦

The various kinds of joints, the different brazing alloys, the methods of brazing and their results are considered, as one of many of the faulty practices which may give rise to poor brazing results. ✦ ✦ ✦ ✦

Examples of various brazes are shown, and the metallurgical processes involved in the brazing operation are correlated with the properties of the finished joints. ✦ ✦ ✦ ✦

The various brazing alloys in general use, their properties and recommended uses are also fully considered.

IN an industry which uses the tremendous amount of copper such as is consumed annually in the manufacture of electrical equipment, the brazing of copper is of vital importance in the processing and assembly of parts. Consequently, this subject has received a vast amount of attention from those closely associated with the metallurgical aspects of this work, in order that the methods and materials best suited for the production of brazed joints of the highest quality could be ascertained.

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THE analysis of a proposed brazing operation is not merely a matter of selecting from a rather imposing array of possible brazing solders an alloy which would seem to be satisfactory, but rather resolves itself into a number of factors, among which might be cited—

1. **The physical requirements of the completed joint.**
2. **The electrical requirements of the completed joint.**
3. **The type of joint required.**
4. **The classification as to desire of permanence, or possible necessity to reopen and rebraze.**
5. **The uniting of additional brazes on the original joint.**
6. **The effect of the braze on the copper being joined.**
7. **The brazing alloy which will meet these requirements.**
8. **The brazing method which will accomplish the above requirements.**

✦ ✦ ✦

Physical Requirements

THE physical requirements of the completed brazed joint must of necessity be considered from several different angles, inasmuch as in dealing with copper there is a two fold range, from approximately 31,000 to 62,000 p.s.i., in tensile strength between the annealed and cold worked metals, and a proportionate range in the fatigue or endurance properties.

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AT the same time it is possible to obtain brazing alloys, the tensile strengths of which are greater than that of cold worked copper. However, in many of these alloy combinations, or in the combination of a number of these alloys with copper, there may develop brittle structures which may have sufficient tensile strength, but, at the same time, be quite lacking in endurance properties, ductility, etc.

✦ ✦ ✦

PHYSICALLY, the finished joint should represent a complete filling of the space between the pieces to be joined by a solder which will unite with both members, and, in doing so, result in a completed joint which is as strong or stronger than the copper which it unites. This includes consideration of tensile strength, ductility, malleability, fatigue resistance, strength at elevated temperatures, bending, wear and corrosion resistance.

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THE performance of the brazing operations in a reducing atmosphere may seriously embrittle any oxygen bearing copper being brazed and consequently result in weakness in or adjacent to the joint, as will be pointed out later.

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BRAZING, as the name indicates, originally concerned the use of various brasses as the uniting media, but when one scans the list of brasses which are being and have been used for the brazing of many metals, it becomes apparent that, in covering the range from

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33 to 66% Zn with corresponding copper contents, temperatures of 1400° to nearly 2000°F are required for their use, and these temperatures are too high to expect much strength from the finished joint. The consideration in this instance being the overheating of the copper to where it is in a soft, weak condition.

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THAT the finished joint must be as strong or stronger than the original material is somewhat of an overstatement in the sense that if cold worked copper were to be brazed, the heating in the area of the braze would anneal the copper in this area, thus reducing its physical properties. Nevertheless, it is not an overstatement in the sense of what is desired, or can be practically approximated.

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FOR instance, in drawing copper, if a braze is made between coils in order to maintain the continuity of the process, a severe overheating of the copper would leave areas of large grained soft copper through and on either side of the braze itself. The wire or rod would tend to neck down in these areas due to the imposed tension, and result in a skip which would cause subsequent breakage. Furthermore, the brazing together of parts of widely differing size will prove disadvantageous to the smaller part, due to overheating, unless particular care is taken in the process.

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IN another instance, wherein flexible leads are brazed to solid bus bars, etc., if the copper is overheated, the endurance properties of the flexible lead will be severely diminished due to the annealing action. This can be minimized, however, by the wrapping of the flexible lead[1] with copper strip in which case the wrapper has enough effect on the functioning of the joint to shift and distribute any tendency for stress concentration away from the actual braze, as well as serve as a protection against harmful atmospheres, Fig. 5.

✦ ✦ ✦

THE clearances between the pieces to be brazed should be kept down to a few thousandths of an inch, and deviation from this rule will tend to cause weaker joints, as so excellently illustrated by Leach[2] [6] in citing the brazing of stainless steel of 160,000 p.s.i. tensile strength with a silver brazing alloy having a tensile strength in the annealed condition of 65,000 p.s.i. The results showed that with clearances of .0005″ to .0015″ the tensile strength increased from 100,000 to 134,000 p.s.i. due to the increased ability of the brazing alloy to completely wet and cover all the surfaces of the joint. Beyond this latter clearance and up to .025″ clearance the tensile strength fell off to 45,000 p.s.i., as only the silver solder and its brittle formations were being tested.

✦ ✦ ✦

CLEARANCES should be kept small in the interests of high strength, and, the loading of the outside of a joint with excess solder is but a waste of expensive metal. Clearances maintained at .002″ between parts being joined can be recommended as good practice. Furthermore, the low endurance values of the solder itself, particularly when thick, may lead to cracks which will follow through into the copper itself and lead to early failure.

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RECOMMENDED practice dictates that for the design of lap joints which are subject to shear, the lap should be so made that the shear area is fully three times that of the sections being joined.

✦ ✦ ✦

CAREFUL attention should be given to the matter of stress distribution through a brazed joint, for it may be necessary to so design the braze that any sharp re-entries, etc. are eliminated by design of members to be brazed and by filleting the silver brazing alloy in order to shift the concentration of stress outside of the joint itself.

✦ ✦ ✦

IT must always be kept in mind that in every braze in which the solder is applied to the heated assembly, the solder is actually carried into the interstices of the joint by capillary action. Consequently, these openings must be kept small in order that the capillary action may be maintained.

✦ ✦ ✦

THIS is beautifully illustrated in the instance of lap brazing two stranded cables by flattening and clamping the wrapped overlapped ends between the jaws of the brazing tongs. The natural tendency would be to apply the solder to the side of the assembly, but, keeping the capillarity in mind, it should be evident that the solder is best applied to the cut ends. By so doing, the stranded cable acts as a wick, pulling the alloy into itself, making it "solidified" and flowing outwardly as well until the two pieces are united. Comparable practice is employed in brazing stacks of laminated leads.

✦ ✦ ✦

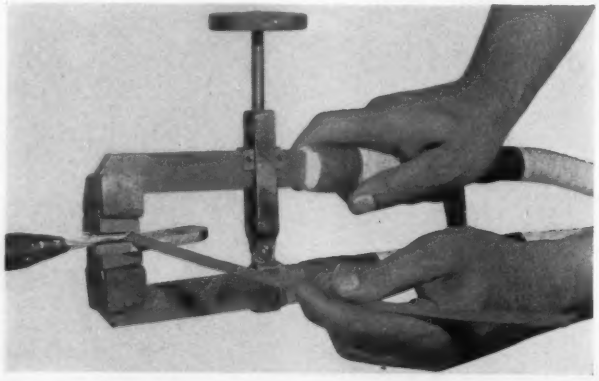

Figure 5.

✦ ✦ ✦ ✦ ✦ ✦

THE union of the members of an assembly by completely filling and uniting them at their common interfaces should be a cardinal principle of brazing. The assurance of strength and conductivity and the maintenance of the capillarity necessary to accomplish these ends may all be interpreted on a common basis — keep the clearances small.

Electrical Requirements

AS far as the electrical conductivity is concerned, it must be kept in mind that brazing solders do not have particularly good conductivity, the range varying from 17% to 77% of copper conductivity, the latter being the Ag-Cu eutectic of 72% Ag, 28% Cu,—a rather expensive alloy.

✦ ✦ ✦

HOWEVER, practical experience has shown that by using silver brazing alloys which even though somewhat expensive will insure good physical properties in the completed braze, these same solders will give both physically and electrically satisfactory joints if the ratio of the brazed area to the cross section is of the order of 3:1, using recommended clearances. This is because the actual amount of solder present is comparatively small[3].

✦ ✦ ✦

THIS is ably demonstrated in the instance of butt joints where a 50/34/18 brazing alloy having a conductivity of but 24.1% that of copper shows a conductivity of 103.8 through the joint.

✦ ✦ ✦

IF a lap braze has an overjoint of at least 1½ times the cross section of the smaller of the pieces being joined, then the resistance of the joint will be less than that of the conductor itself.

✦ ✦ ✦

Type of Joint

FROM both the physical and electrical standpoints, the lap joint is preferable to most other types of joints and should be used whenever possible in making assemblies, as should be evident from the foregoing discussion.

✦ ✦ ✦

REQUIREMENTS may necessitate the use of a straight type of joint in view of subsequent working, or forming operations and either a scarf- or butt-joint might be used.

✦ ✦ ✦

IN the former, the two pieces are usually cut off and the cut ends so shaped that they form a joint across the strip axis and at an angle to the flat face of the conductor. The area of this section to be brazed may vary up to two or three times the strip cross-section, the area increasing with increasing thickness of the conductor.

✦ ✦ ✦

ANOTHER type of lesser used scarf joint is made by the butting together of the two pieces which have been cut at an angle to the strip axis, but perpendicular to the flat face—really a true butt joint elongated by having an angle of, say, 45° instead of 90° to the strip axis. This joint finds merit where edgewise bending is necessary.

✦ ✦ ✦

THE common butt joint is used as little as possible, and even then it is made with particular care. The reasons for this lie mainly in that the strength of the joint is but that of the silver brazing alloy in tension, and the conductivity is that of the solder —neither very favorable. Consequently, it is imperative that a ductile solder of high strength and conductivity be employed.

✦ ✦ ✦

WHEN stranded wire cables, braided leads, or leads made of laminated strips are to be brazed, the solidified type of joint should be used. In these joints the individual pieces are usually wrapped, flattened and the assembly clamped in the tongs. The brazing is accomplished by allowing the solder to flow into and fill the ends of the pieces by capillarity, and the actual joint is really accomplished by uniting to the wrapper, Fig. 5.

✦ ✦ ✦

THE brazing of a number of winding leads to a common conductor or terminal at the same place requires considerable care because of the various stresses which may be encountered. Because of this, it is advisable to limit the number of strips that can be brazed together, particularly vertically, to not over four.

Type of Braze

THERE are two additional factors (4 and 5 above) which find some interrelation for they require brazing alloys which are of a similar type, that is, alloys possessing a melting range.

✦ ✦ ✦

IN binary alloy constitution diagrams, such as that of Ag-Cu, two of the basic metals in the best present day solder, it may be observed that at the eutectic, 72% Ag, 28% Cu, at 1435°F, the alloy melts at a temperature, but at compositions to either side of the eutectic, there exists a range of temperature between the liquidus and solidus in which the solder is part liquid and part solid—somewhat mushy.

✦ ✦ ✦

THIS mushy range can be capitalized on in those instances where a second braze is to be superimposed on one already made, for the metal may be heated to accomplish this second braze without loosening the original joint, provided there is an adequate melting range in the silver brazing alloy employed. The heat conducted through the copper to the first joint will not be enough to cause sufficient softening of the solder in the original joint to result in partition.

✦ ✦ ✦

A GOOD example of this is the use of the 30/38/32 solder (M. P. 1375°F, F.P. 1455°F.) for the first brazed joint, and using the 50/16/16/18 (M.P. 1160°F., F.P. 1175°F.) alloy for the subsequent adjacent brazes.

✦ ✦ ✦

BY the same token, where it is necessary to open and subsequently rebraze joints, it is almost imperative to select solders on the above basis. For instance, a good solder for this purpose is the 55.5/4.5/40 Cd alloy having a M.P. of 1265°F, a F.P. of 1365°F, but which unsolders at 1335°F.

✦ ✦ ✦

THIS same factor of wide melting range is sometimes used to advantage where subsequent

operations on equipment containing brazed joints must be at quite elevated temperatures. As a matter of fact, this is capitalized upon by the use of silver solders of 50/50 Ag/Cu or over.

✦ ✦ ✦

Effect of Braze on Copper

REFERENCES have already been made to the possible deleterious effects obtained by causing excessive annealing and grain growth in the copper being brazed, by subjecting it to too high temperatures, and/or protracting the brazing operation unnecessarily at even moderate temperatures. However, there is another factor which is of vital importance which consists of the effect of the method used on the copper being brazed.

✦ ✦ ✦

TOUGH pitch copper, containing on an average of about .035% oxygen forms the major tonnage of the copper used today in industry —and any copper, such as this, is subject to embrittlement when hot and in the presence of reducing gases[4].

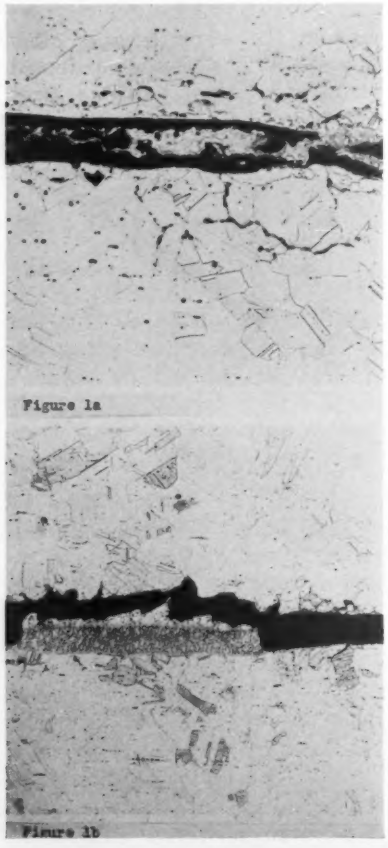

Figure 1a

Figure 1b

CURIOUSLY enough, very little attention has been given in the past to the effect of a very superficial embrittling action on the surface of copper in the joint. Such embrittlement disrupts the continuity of the metal and leaves it brittle.

✦ ✦ ✦

IN the event the brazing operation on tough pitch copper is carried on under conditions which cause embrittlement only a couple of grains deep in the surfaces to be joined, the operation will be accomplishing nothing more than the partial union of two surfaces of embrittled copper, with the net result that the "braze" can be stripped apart very readily, and has low endurance values.

✦ ✦ ✦

ACTUALLY it is not the braze that is stripped apart, but it is the embrittled copper which is parted, as the typically salmon colored appearance of such a stripped section should immediately make evident.

✦ ✦ ✦

THERE is too frequently a desire on the part of an operator to rush through the brazing operation, which means that he literally "pours" the heat on the outer surface, and not to particularly good advantage because it takes time for this heat to penetrate. Instances have been found where this pushing of the heating has actually caused the fusion of the copper on the heated surface, leaving a porous cast copper of considerable weakness. And, too, the application of silver brazing alloy to such a hot joint may cause the volatilization and loss of some of the necessary constituents of the solder.

✦ ✦ ✦

TOUGH pitch copper is not the only offender, for many "deoxidized" coppers may be incompletely deoxidized or may have been oxidized subsequent to deoxidation[5]. By the same token the oxygen-free copper may be spoiled by previous oxidation[4], in either event the resultant copper can be embrittled.

THIS condition of shallow embrittlement is quite evident when Fig. 1a, which shows a well brazed joint, the braze uniting only two areas of embrittled copper which will readily rupture as in Fig. 1b, is compared to Fig. 2a which shows a well brazed joint with good penetration.

✦ ✦ ✦

IN order to accomplish the best results, the brazing temperature should be but very little above the flow point of the solder. This may be expressed in terms of temperature where pyrometric checks have shown that 100°F above the flow point is definitely ample allowance and that 200°F above the flow point on many brazing alloys is on the border of causing damage.

✦ ✦ ✦

Silver Brazing Alloys

THE selection of a suitable abrazing solder is all too frequently made on the basis of cost rather than that of the quality of the resultant brazed joint, all of

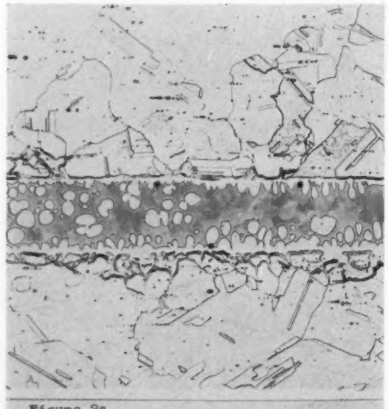

Figure 2a

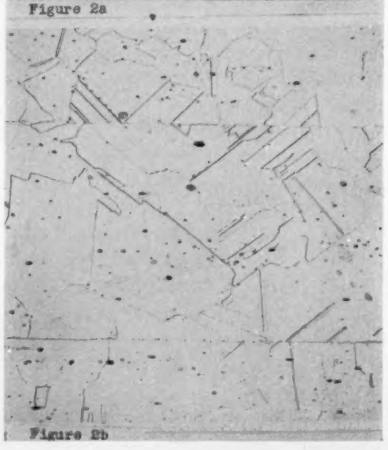

Figure 2b

which is not a procedure to be recommended in the interests of good joints.

✦ ✦ ✦

AS to the brazing alloy to be utilized, past experience has ably demonstrated that the brasses are out of consideration because of the high temperatures involved, (as in welding) and also because of their tendency to produce brittle compounds. Soft soldering is eliminated because of its use of low strength, low conductivity alloys, thus only brazing with alloys other than the brasses remains.

✦ ✦ ✦

IF those of us who deal with metals could only be in a position comparable with that of a carpenter, who knows that he can glue two pieces of wood together so well that the wood will rupture rather than the joint, we would be in an enviable position with regard to the brazing of copper, or the joining of any metallic combination. Unfortunately we must be content with "beggars choice" and resort to what is available.

✦ ✦ ✦

FUNDAMENTALLY it is possible to correct the faults of the brass (Cu-Zn) brazing alloys by increasing their ductility, malleability, conductivity, etc., by silver additions to the extent of the range of from silver diluted brasses to zinc dilutions of the Ag-Cu eutectic, to accomplish lower melting points.

✦ ✦ ✦

ON the other hand, the Cu-P eutectic, and its partner, the Ag-Cu-P ternary offer possible alloys — the disadvantage being that with enough of the Cu and P combination present there is the possibility of having formed the brittle Cu_3P intermetallic compound—which is certainly not to be recommended.

✦ ✦ ✦

COPPER can dissolve but a per cent or so of phosphorus, and any P content above this amount goes to form the brittle Cu_3P. For this reason, the phosphor-copper brazing alloys should only be used where the phosphorus content or phosphorus contentless-loss brings the alloy into a reasonably ductile range of composition. Where this is, in composition, still remains somewhat problematical, so that recourse is more advisably taken to the Ag-Cu-Zn ternary, and the Ag-Cu-P alloys containing low amounts of phosphorus.

✦ ✦ ✦

PHOSPHORUS is a powerful deoxidizing agent, and if present in sufficient quantity in brazing solders will require no additional flux to satsfactorily accomplish a good braze. For this reason it is very advantageous, in addition to the low melting characteristic attributable to the Cu-P binary eutectic.

✦ ✦ ✦

PROBABLY the most advantageous alloy is the combination of the above mentioned alloys into a silver brazing alloy (proprietary) which contains 15% Ag, 80% Cu and 5% P, having a melting point of about 1200°F and a flow point (the temperature at which it will readily flow into openings of capillary size) of about 1300°F.

✦ ✦ ✦

THIS particular alloy has good tensile strength at room and elevated temperatures, sufficiently good electrical conductivity in thin sections, a moderate loss of strength with increasing temperatures, high ductility, malleability, wear and corrosion resistance. Indeed, quite a happy combination of properties to be attained at quite moderate brazing temperatures.

✦ ✦ ✦

AS a consequence of this, the above alloy, although far from being as commercially inexpensive as other alloys, is capable of pro-

TABLE I

Chemical Comp							Melt Point °F	Point Flow °F	T.S. 1000 psi.	Elng. % in 2"	Cond. % Cu	Color
% Ag	% Cu	% Zn	% Cd	% Sn	% Pb	% P						
2.5	0.25				97.25		1055	1235				White
5			95				1185	1365				White
5		16.5	78.5				895	1112				White
5.5					95		1075	1320				White
10	52	38					1510	1600	49.0	16.0	21.0	Yellow
15	80					5	1190	1300			3.9	Yellow / White
20	45	35					1430	1500				Yellow
20	45	30	5				1430	1500	53.0	12.0	24.4	Yellow
30	38	32					1375	1455		24.4		Yellow
45	30	25					1250	1370			19.0	Near White
50	15.5	16.5	18				1160	1175				Near White
50	34	16					1280	1425			24.1	Near White
50	50						1600	1650				
55.5	4.5		40				1265	1365				White
65	20	15					1280	1325	64.8	34.0	21.3	White
70	20	10					1335	1390			26.7	White
72	28						1435	1435+			77.1	White
80	16	4					1360	1460	50.1	16.0	45.8	White
	92					8	1324	1835				Yellow

ducing a brazed joint of most superior qualities, and is consequently the one used in quality brazes.

✦ ✦ ✦

TABLE I shows the composition and some of the pertinent data (insofar as available) concerning some of the more widely used silver brazing solders.

✦ ✦ ✦

Brazing Methods

THE foregoing discussion has considered several factors such as overheating, clearances, embrittlement, solders, etc. which are common to all the brazing methods. These factors must of necessity place the responsibility on the operator to see that all requirements are covered. He must have the proper assembly, heat it carefully and uniformly to where the flow of flux and solder show that a satisfactory bond is being made and, after the solder application, insure the exertion of adequate pressure to keep the assembly tight until cooled below the solidification of the solder.

✦ ✦ ✦

THE outstanding development of recent years is the carbon block brazing method where the pieces to be brazed are clamped between the carbon block jaws of brazing tongs and the union completed by either placing the solder between the clamped faces or by applying solder after the joint has been heated by the resistance of the carbon blocks. All of the brazing requirements are more nearly met by this method than by any other.

✦ ✦ ✦

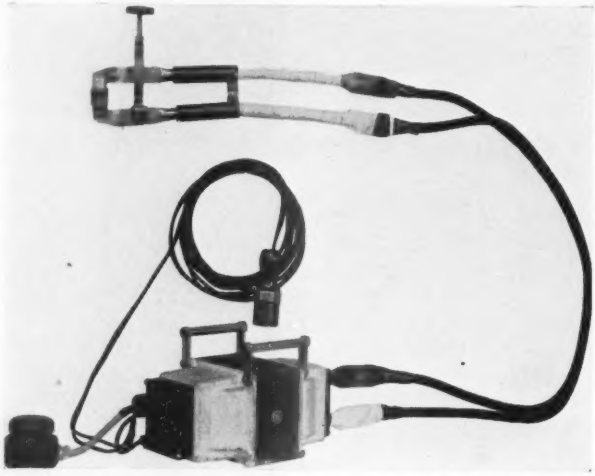

Figure 3.

✦ ✦ ✦ ✦ ✦ ✦

WHEREVER scarf joints (edgewise or flat), butt joints, laps, etc. are feasible, the carbon block method with its use of but small and highly portable equipment with simultaneous application of heat and pressure[1] makes a most suitable and versatile method for portable or stationary (Fig. 3) brazing equipment.

✦ ✦ ✦

BY selecting the grade of carbon block used, it is possible to vary the surface contact resistance and thus the heating rate to a considerable extent. The making of a single joint such as a scarf, butt or lap braze in rectangular stock can be made by clamping the flat face between the blocks, Fig. 4a, or a scarf braze can be made by clamping the stock at the edges and applying the silver brazing alloy to the face of the joint as in Fig. 4b.

✦ ✦ ✦

MANY structures, of course, are of such shape and contour as to preclude the use of anything but torch methods of brazing, and in this connection it is found that the oxy-acetylene torch with its wide heating range, and wide choice between reducing and oxidizing zones within the flame is far better than oxygen gas or air gas combinations.

✦ ✦ ✦

THE electric resistance method is peculiarly advantageous because it localizes the heating to affect brazing, and, whether the operation be done by placing a solder film in the braze or applying the solder to the preheated braze, the heat affected area is at a minimum.

✦ ✦ ✦

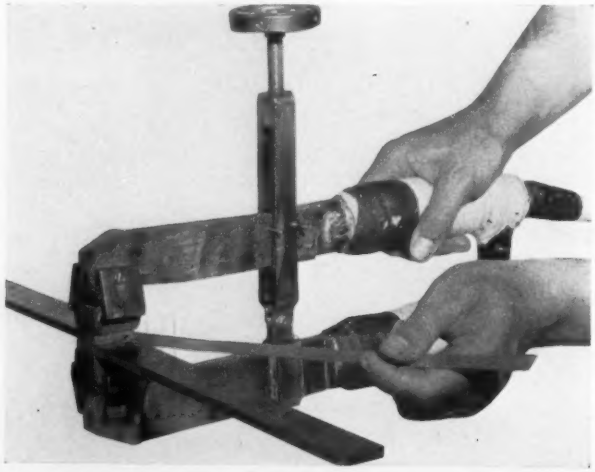

Figure 4a.

✦ ✦ ✦ ✦ ✦ ✦

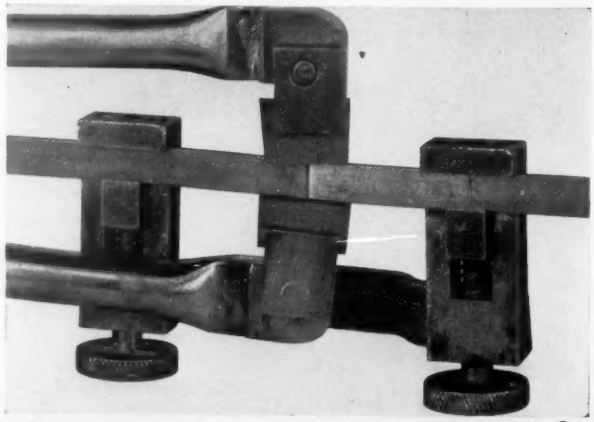

Figure 4b.

✦ ✦ ✦ ✦ ✦ ✦

THE equipment is so designed that the current flows only when contact is made by a foot-operated push button. Thus by balancing the input by the frequency with which pulsations of current are sent through the assembly, a very uniform and well controlled heating to brazing temperature can be accomplished. In addition, this method permits the accomplishment of the brazing while the assembly is constantly under pressure, thus insuring small clearances and effective capillarity, resulting in joints of the best quality.

✦ ✦ ✦

WHEN, because of structural limitations, it is necessary to resort to torch methods of brazing, it is imperative that the operation be so conducted that the copper in and adjacent to the braze should be protected from oxidation or embrittlement by the cloaking action of suitable brazing fluxes, such as borax, boric acid, alkaline bifluorides, or similar combinations which not only serve to clean the surfaces to be brazed, but also protect the metal during and after the brazing operation.

✦ ✦ ✦

BECAUSE of the accelerated attack on the copper afforded by the "corrosive" type of fluxes, they are to be favored over the so-called "non-corrosive" fluxes, for the assurance of the clean and easily metable surfaces so essential to the accomplishment of satisfactory joints is far greater. Of course, the readiness with which the excess of a corrosive flux can be removed after brazing may be the deciding factor as to whether or not it may be used.

✦ ✦ ✦

THE danger of causing embrittlement of the copper is particularly great when torch methods are used, and the danger increases with the use of hotter torches unless the increased heat is fully utilized in shortening the brazing cycle. Furthermore, strict attention must be paid to the part of the flame which impinges on the work for, unfortunately, that part of the flame which is hottest is also the portion which is the most damaging from the embrittlement standpoint.

✦ ✦ ✦

FOR special applications, and for some particular assemblies, such methods as dip brazing by immersion in a bath of molten brazing solder, or the immersion of prepared assemblies into baths of fused salts find some application in the electrical industry.

✦ ✦ ✦

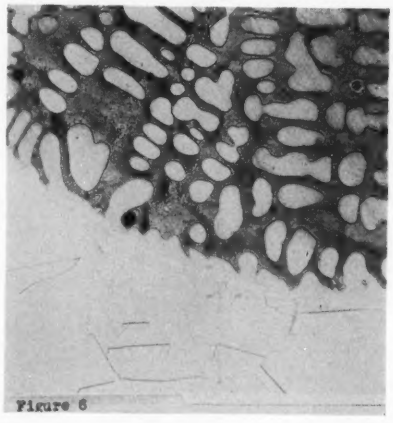

Figure 6

THE furnace brazing method, using controlled atmospheres is not in general use on copper at the present time, although it is being used on copper to steel assemblies[5].

✦ ✦ ✦

THE use of high frequency heating methods finds some application in the brazing of assemblies which must be closely controlled, for it is quite easy to set up an assembly on a jig, cover it with a bell-jar and, after evacuating, make a braze by high frequency heating, the entire operation being visible. Over heating can be nearly eliminated, and the final product is not oxidized at all.

✦ ✦ ✦

A BRAZED joint is actually a thin casting of an alloy which has a lower melting point than copper, and which unites the copper pieces by holding both faces of the joint together.

IN order to do this satisfactorily, the solder must be able to thoroughly "wet" the entire surfaces to be joined, and preferably be capable of mutual solubility with the copper. When these conditions exist, then the solder becomes a means of actually growing the joint members together.

✦ ✦ ✦

THIS mutual solubility action can be readily observed in Fig. 6, which is the solder-copper junction in a braze which was held for some time at an elevated temperature in order to intensify the diffusion and solution actions.

✦ ✦ ✦

IT may be noted that there is a diffusion band in the copper which marks the depth of penetration of some of the solder components into the copper, and that some of the copper-rich phase has formed dendrites in the solder body itself.

✦ ✦ ✦

SOLUTION and diffusion require both time and temperature in order to take place, thus as much of these two as can be utilized without danger to the copper itself should be utilized in the interests of good bonding.

✦ ✦ ✦

IN many cases where the clearances are small and the joint is made under pressure, such as in the carbon block method, it is possible to have this "growing together" almost literally true as can be seen in Fig. 2b.

✦ ✦ ✦

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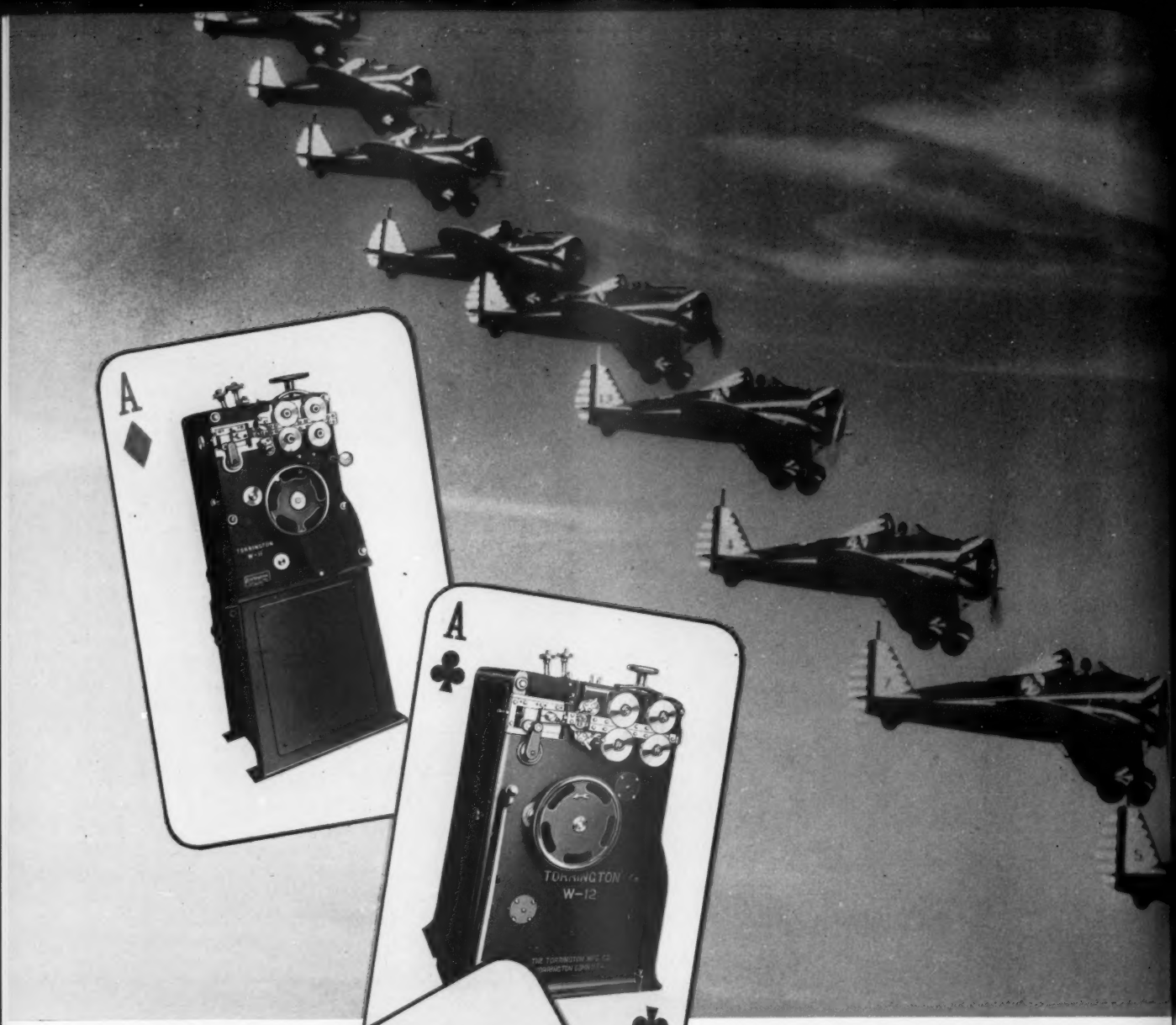

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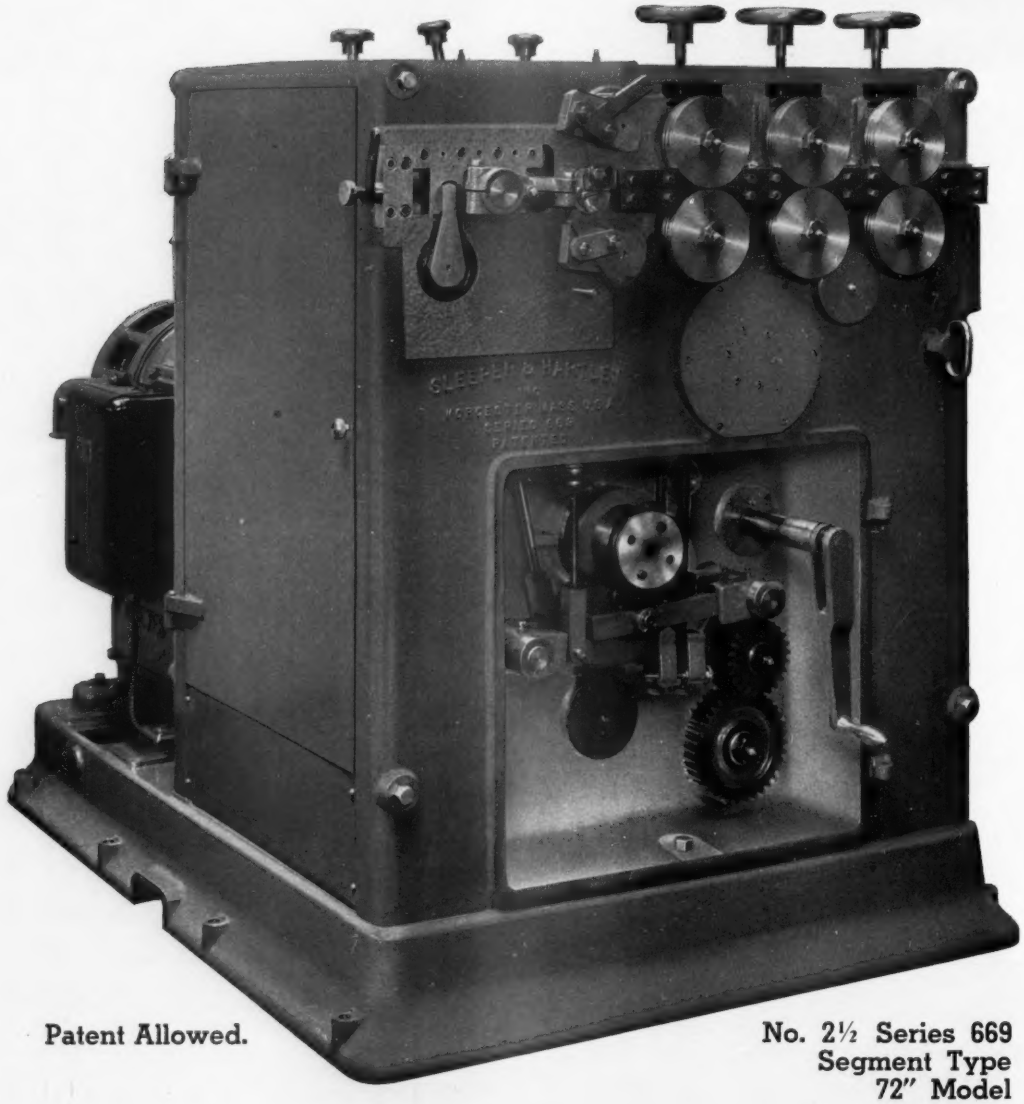

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Insulation of Telephone Wire With Paper Pulp

By J. S. Little,
Manufacturing Engineer,
Western Electric Company, Kearny, New Jersey

The paper presented here covers the history and development of wood pulp insulation for telephone circuits. The development involved the study of wood pulps and their preparation, the methods of applying such pulp to wire, and the development of the necessary properties within the insulation to make it suitable for telephone use. The use of this insulation has made it possible to greatly increase the number of telephone circuits in a given cable by using finer wires and thinner insulations. ✦ ✦ ✦

EXCHANGE area telephone cable consists of individually insulated copper wires twisted together into pairs and the pairs grouped together in varying numbers to form the cable core. The core is then wrapped in paper and covered with a lead sheath. The history and manufacture of pulp insulation for this type of cable is the subject of this paper.

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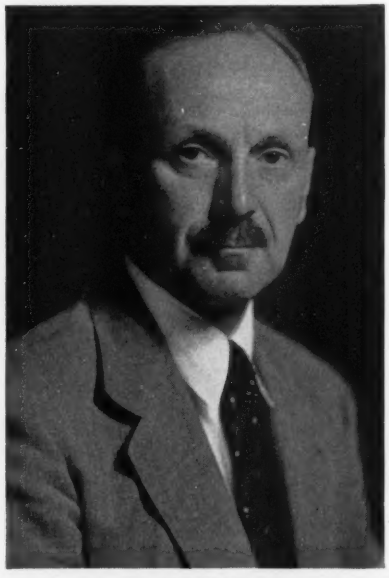
Historical

UP to the year 1890 telephone cables with wires insulated with rubber, gutta percha or cotton impregnated with paraffin or tarry mixtures were common types. Among the companies manufacturing cables were the Western Electric Company, the Eugene Phillips of Providence and the A. G. Day of New York, each with different ideas as to how the cables shold be constructed. The Western Electric cables followed a system designed by Mr. Patterson in which the copper wires insulated with cotton were pulled into a lead pipe and the pipe then filled with paraffin to completely imbed the wires. The Phillips cables were made up of rubber or gutta percha insulated wire wrapped with tin foil for shielding purposes and the whole covered with waterproofed canvas. The Day type consisted of a special rubber compound used to cover the conductors over which a tin foil was placed and then a rubber tape applied over the whole. These cables were made of copper wire of various diameters and utilized a grounded circuit. The use of pairs of wires did not enter the picture in any considerable amount until about 1887 when J. J. Carty's experiments made it possible to use such a system successfully.



J. S. LITTLE

Associated with the Western Electric Company since 1922 being engaged almost continuously with development work in connection with insulating wire for lead covered exchange area cable. At present in charge of manufacturing development work on lead covered exchange area cable and wire and vacuum tubes with the title of Manufacturing Engineer.

Development of Paper Insulation

IN 1887 the leading telephone engineers attempted to standardize telephone cables and specifications, finally deciding upon #18 B & S gauge wire covered with two wrappings of cotton and twisted into pairs. A maximum cable size of 52 pairs in a two inch diameter cable sheath 97% lead, 3% tin, and 1/8" thick was permitted under the specifications. The grounded capacity of such cable was 0.20 mf per mile. In 1891 the Western Electric Company had made successful application of manila rope paper as insulating material for dry core cable and by drying this paper immediately before covering with lead by the newly developed extrusion process the core could be kept dry without the old impregnation with hot paraffin. A great improvement in electrical properties resulted from this change, the electrostatic capacity dropping to approximately one-half its former value. The use of manila paper made from old rope from this time on grew in use for insulating purposes. The telephone demand was increasing all the time, and since the supply of old rope depended in a large measure or maritime sources of supply the price began to increase. The increased demand for telephones also made it more economical to use finer and finer wires in a given diameter of cable, as the improvements in the instruments themselves took place. This trend can be readily seen if we follow the change in maximum number of pairs used at different

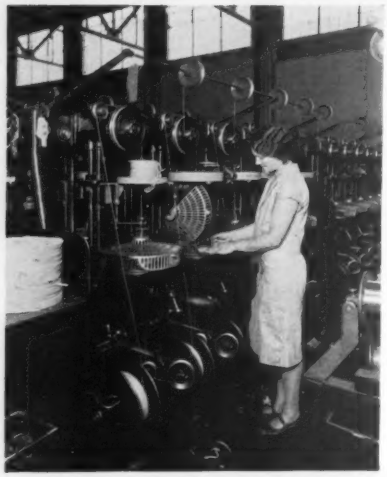


Fig. 1. Paper Insulating Machine.

dates. In 1888—50 pairs of 18 gauge wire were used, 1896—180 pairs 19 gauge, 1912—909 pairs 22 gauge, 1914—1212 pairs 24 gauge, 1928—1818 pairs 26 gauge, and in 1939—1515 pairs 24 gauge and 2121 pairs 26 gauge. Recently 3030 pairs 28 gauge using the insulation described in this paper has been made on a trial basis. The increasing number of wires demanded thinner and thinner and better and better paper. As the cable demand increased, increased insulating speeds were necessary to aid in keeping down the cost due to the higher priced papers. Increased flexibility of paper without sacrificing strength and greater uniformity were required in these new thinner papers. Considerable time and money were spent in attempting to reduce the amount of manila fibre due to its price and increased scarcity and to substitute cheaper fibres of wood and cotton. It was finally found that mixtures of 45% rope, 40% wood and 15% cotton could be used for all but the very finest insulating papers and that as high as 80% wood and 20% manila rope could be used for the coarser wrapping papers.

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IN spite of these changes and the improved paper making technique developed by the industry in use of paper ¼″ x .0025″ for insulating 26 gauge wire was not entirely satisfactory from a manufacturing point of view. About 1920 some of our engineers began developing the idea of manufacturing the paper right on the wire. If this were possible there seemed to be no reason electrically why wood pulp would not make a suitable insulating material, and from the mechanical standpoint many of the difficulties involved in wrapping the insulation would be eliminated. It was anticipated, of course, that a whole new set of troubles would be encountered but as usual because they were unknown were not particularly feared.

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The Development of Pulp Insulation

The Pulp Machine

THE first crude experiments on insulating wire with pulp were done by pouring a suspension of pulp over a wire backed up by a fine mesh screen and after the water was drained away lifting the wire up together with whatever fibres clung to it and then rolling the wire on a flat surface. These samples gave an idea of the type of product to be expected and looked so interesting that a study of equipment and methods was authorized. It developed that the machine most adaptable for our purpose was the standard single cylinder paper machine in use in the paper making industry. The essentials of this machine are a vat for holding a thin pulp suspension and a hollow cylinder covered with fine mesh screen immersed in the vat. Suitable dams at the ends prevent the pulp suspension passing into the interior of the cylinder. As this cylinder rotates on its axis the water flows through the screen and deposits pulp on its surface. This pulp mat is then picked up by an endless felt belt which is brought into contact with the surface of the cylinder by means of a soft rubber roll which presses it firmly against the pulp mat on the surface of the cylinder. The pulp mat adheres to the felt and together they travel to squeeze rolls where a second felt is laid over the pulp before squeezing the excess water out. The fibres are thus firmly pressed together so that a sheet of wet paper is formed. After drying and calendering the paper appears in its usual form.

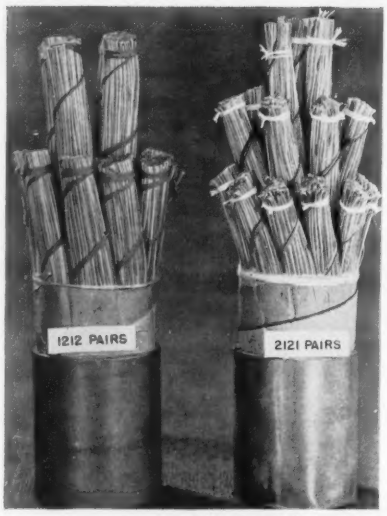

Fig. 2. Comparison of 1212 to 2121 Pair Cables.

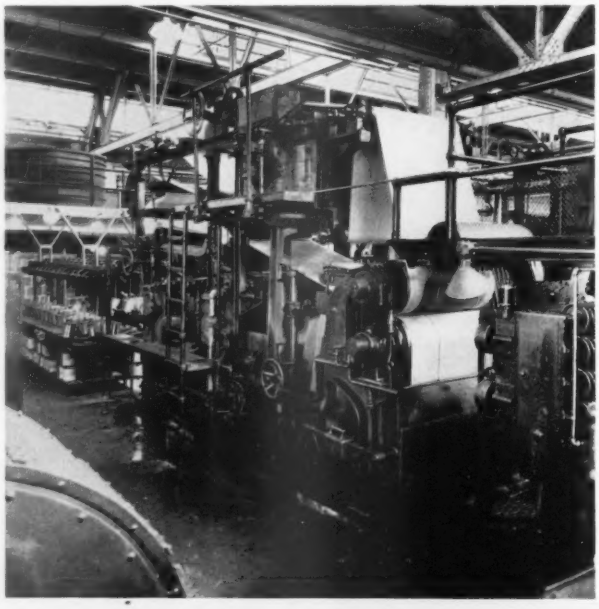

Fig. 3. Forming End of Pulp Insulating Machine.

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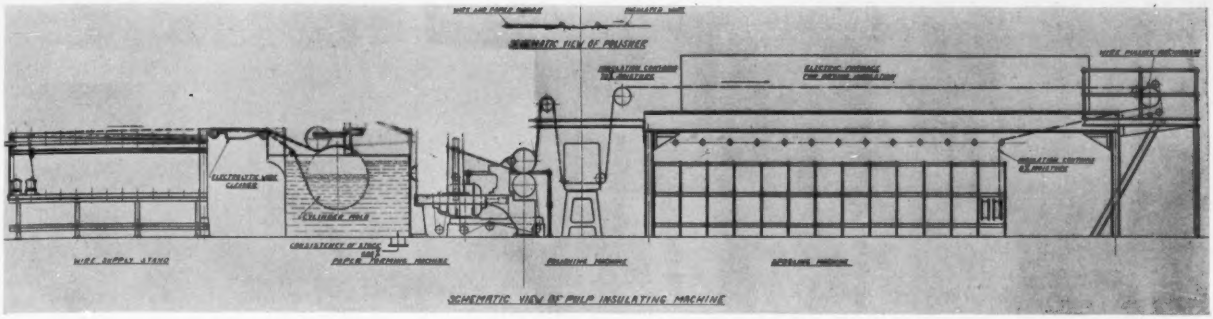

Fig. 4. Schematic of Pulp Process.

THE idea of embedding a wire in the sheet as the pulp was deposited on the cylinder formed the basis of the present development. Usually the paper machines produce a continuous sheet eight or nine feet wide so that it became necessary to devise ways and means of producing sheets only about one quarter inch wide to supply the necessary material for insulating wires of 22 gauge and smaller. The most practical size of commercial machine was no less than three feet wide but by painting annular rings on the cylinder screen surface the effect of a series of small cylinders all immersed in a single vat could be produced. This was the scheme finally adopted for preparing the paper making machine and we have standardized on a cylinder three feet long with enough rings to simultaneously produce sixty sheets of paper approximately ¼" in width.

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Pulp Supply

KRAFT pulp is among the toughest of the wood fibres as well as one of the cheapest. It is prepared by an alkaline process and our experience indicated that this process produced pulp of a greater degree of permanence than the acid processes unless special treatments were used. The chief drawback to its use was its color, brown or tan, which necessitated a change in the color code in the cables. Fortunately, cable designs could be made using fewer colors than had previously been employed so that this obstacle was not serious. Standard paper making beating equipment was purchased and used for preparing the pulp to form the sheets although special beating technique for our purpose had to be developed. The beating consists of grinding the fibres in the presence of water under a heavy roll. By this continuous maceration the pulp is softened and fibrilated and made suitable for paper making. The longer the grinding the more parchmentlike the final paper becomes, and as we desire as porous a paper as possible it is necessary to control the beating to a point where good strong paper will be made but will still contain a high degree of porosity. Within the last few years a continuous beating system has been developed to replace the original batch system. In this method the pulp mixed with water is run through a preliminary hydrofiner where the pulp is partially beaten before being stored in a large tank. From this tank it is then fed to the various machines and colored by adding the proper dye. A further refiner in the line to each machine finishes the beating for the particular insulation being made in that position. Study showed that fibre from different sources of wood supply handled differently so that standardization of sources of supply had to be made and methods of test developed to check on new fibres or new sources of pulp.

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DUE to the small thin sheets made on the machine, the amount of pulp required per unit of time is extremely small. No commercial means of measuring such quantities accurately had been developed and it was necessary to spend considerable time in this study. The suspension of pulp to be measured contains only 1.5% fibre and this is further diluted to .05% in the machine vat. The actual quantity of liquid measured is about 8 gallons per minute. The device most recently adopted is similar to the jaws of a pair of pliers held between two stationary guides. As the jaws are separated more liquid flows through them and as they are closed the flow is cut down. A vernier scale adjustment makes close and accurate settings possible when used with a constant head. In the older system the dye for coloring the pulp is added in the beater but the newer

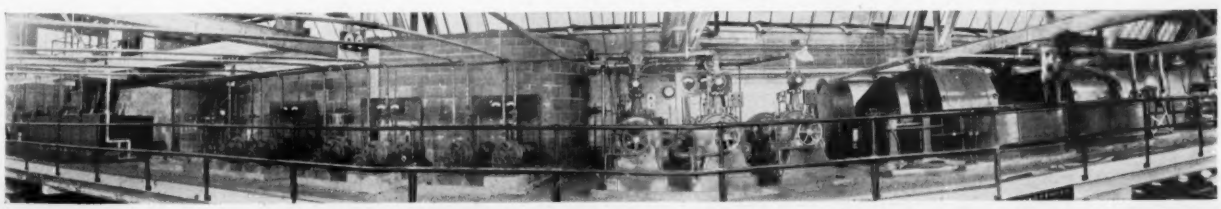

Fig. 5. Continuous Beating System.

system more recently put to use in the Kearny, New Jersey Plant supplies the dye as needed so that only uncolored pulp need be stored in tanks and color changes can be rapidly made with little loss of stock.

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Wire Supply

A MACHINE of this size and difficulty of control necessitated a continuous supply of wire to avoid large losses in junk and lost time. It was necessary to devise methods of continuous feed and to do this wire supplied on spools was utilized. On the earlier machines spools 8″ x 8″ containing sixty pounds of bare copper wire are used, the wire being removed over the head of the spool by means of a flier. At each supply position two spools are placed side by side and a rotative flier with a V-shaped lip reaching two-thirds down the outside of the spool is placed in the head. The wire unwinding from the spool as it is dragged over the flier rotates it and relieves the strain. By using the V-shaped lip the wire leaves the spool at a small angle to the axis and does not tend to stick or pull other turns loose. When the wire is unwound down to only a layer or two the operator by means of a special hook pulls the inner end out and brazes it to the outer end of the adjacent spool. By placing a flier on this spool also the wire will of course transfer from the first to the second spool whenever the braze is reached. It is quite necessary to removing wire in this manner from these small spools to have both spools set at such an angle that a line drawn as continuations of their axes will pass through a common point at least 3½ diameters above the spools. The greater the distance this point is from the spool the easier the unwinding. After the wire has shifted from one spool to the other the empty spool is removed and replaced by a full one to complete the cycle.

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REMOVING the wire over the head of the spool frequently produces kinks and always puts a slight twist in the wire. To remove these two factors some tension or straightening device or both are needed. We have found by passing the wire over a system of small rollers that suitable straightening and sufficient tension can be obtained and then by varying the size of the rollers variations in tension can be made.

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RECENTLY our wire mill at Kearny, New Jersey, has been delivering wire on 400 pound spools and a change in space requirements and supply holders has been necessary. The essentials of removing the wire, however, remain the same.

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Wire Cleaning

IN our early efforts to make insulated wire by this process very erratic results were obtained in the continuity of the insulation. It was finally found that small traces of drawing compound left on the wire made it difficult for the wet pulp to adhere to it during the subsequent polishing operations. Therefore, it became necessary to clean all the wire. Considerable difficulties in designing a suitable cleaner were experienced, but ultimately the use of alternating current together with an alkaline cleaning bath, was found most suitable. The wire passing to the machine comes in contact with the surface of a cleaning solution for a short distance. Electrical contact with the wire is made through guide rolls and the current flows from the wire through the solution to the container. Originally a mixture of cyanides was used as the cleansing agent and the current flow was held to about 8 amperes per square inch surface at 12 volts. Recently a more effective non-poisonous cleansing agent has been developed by using sodium ortho silicate and ivory soap. The passage of the current in either case heats the solution and liberates a rather violent evolution of gas at the surface of the wire. With the soap solution a foam is built up which is continually floated off, carrying the grease, copper, dust, etc. to the sewer. This method keeps the cleaner from concentrating the dirt and consequently eliminates frequent cleaning both of the cleaner and the screen on the cylinder which formerly used to get plugged up with particles of grease carried over from the cleaner by the wire.

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Embedding the Wire in the Pulp

FROM the cleaner the wire is guided into the cylinder machine. It is extremely important at this point that the wire be guided into the center of the small sheets and at such a point on the periphery of the drum that some pulp is deposited below and some over the wire. After passing around the cylinder the wire travels along with the felt and pulp through the presses and finally emerges at the last press embedded in a small sheet of wet paper. It was found that poor pick-up of the fibres often occurred unless the surface tension of the water was lowered by some means. Ordinary soap is used for this purpose. Approximately ten pounds per thousand pounds of pulp

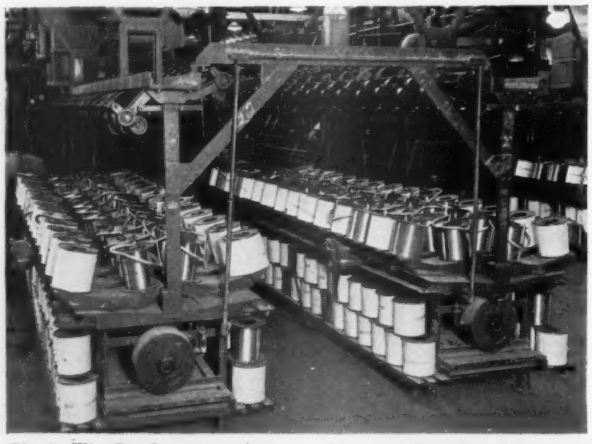

Fig. 6. Wire Supply.

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are dissolved in the storage tanks to give effective results and to smooth out the pickup to give a high degree of uniformity to the weight of pulp per unit length of wire.

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Polishing

POLISHING of the insulation on the wire is brought about by passing the wire and pulp sheet over polishing blocks which are rotated rapidly around the wire as an axis. Three blocks are used and are so placed that the wire is slightly deflected from its course as it passes first over one block, then the second and finally the last. The rapid rotation of the polishing head produces a light rubbing action on the sheet which is rolled down without tearing and results in a good round smooth wrapping of wet paper about the wire. With the wire running at a linear speed of 130 feet per minute the polishers are rotated at 5000 r.p.m. to give satisfactory insulation.

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Drying of the Insulation

THE method of drying the insulation is very important. In the early experiments low temperature air drying, high temperature air drying and finally moderate temperature controlled humidity drying were studied. A temperature of about 180° F. and 20% humidity was finally adopted. For a number of years this method was used for experimental cables but it was impossible to get electrostatic capacities below .095 mf per mi. With such values it appeared that the use of pulp would be strictly limited to certain sizes of wire and certain cables. Study indicated that lack of porosity and close adhesion of the pulp to the wire were large factors in this difficulty and steps were taken to determine what could be done to improve these values. It was found that by drying the wire at very high speeds by passing it rapidly through high temperatures, the natural shrinkage of the pulp could be greatly reduced and that increased porosity could be obtained. Results on capacitance from such wire were markedly better, and so high temperature radiant heat drying was introduced into the process. In this method a box type electric furnace with a heating chamber approximately 26 feet long, 3 feet wide and 8 inches high is used. The wire passes through this furnace horizontally. In the first third of the furnace 1500° F. is maintained, 1200° F. in the second third, and 800° F. in the last third. The water is literally exploded out of the pulp in this process and leaves a soft porous insulation which is easily stripped from the wire. Electrostatic capacitance values of about .072 mf per mi. on 24 gauge cables are obtained with this method of drying and improved centering of the wire and roundness of insulation. These values are practically the same as those obtained with wrapped paper. At wire insulating speeds of 125 per minute the insulation is dried in approximately 12 seconds. Since in case of a shutdown the wire is immediately burned off, a band of nichrome tape is kept in the furnace at all times so that the wires can be tied to it and carried through for restringing. Broken wires are strung in by tying them to adjacent wires to be carried through.

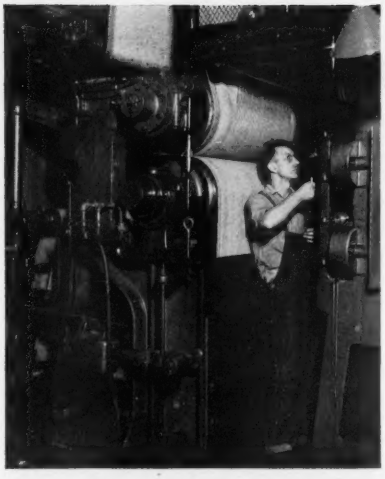

Fig. 7. Wire and Pulp From Presses. ✦

Fig. 8. Individual Polisher. ✦ ✦

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Reeling Up the Finished Wire

BECAUSE it is necessary to shift from full to empty spools without shutting down the machine, dual take-up positions are supplied just as dual feed positions are used. The take-up spools are rotated through a slipping disc clutch, the pressure on the clutch being controlled by the tension in the wire. Before reaching the take-up spool the wire is passed over a tension drum made up of two capstan pulleys separated by a movable housing enclosing and fastened to a coiled clock spring. By running the wire first around one pulley then reversing it by passing it around a pulley on the spring housing and then around the second capstan pulley any tension variation in the wire causes the spring housing to rotate. The rotation of this housing is communicated by a system of rods to the clutch so that it tends to speed up or reduce the speed of the take-up spool. With the long coiled spring wound to a definite tension a predetermined pull on the wire can be maintained. Two spools are driven simultaneously side by side through suitable gears. Each spool, however, is held on a separate arbor which can be pulled out of mesh with the driving gear so that the take-up spool can be stopped and removed. When it is desirable to do this the wire being taken up is simply switched over to the other spool and when a few turns have been taken up the wire between the spools is cut so that the first spool can be removed from the machine. Sixty spools are run at one time at an average speed of 125 feet per minute or a total

wire footage of 7500 feet per minute of running time. Improved beating, better pulp, better cleaning and improved drying and polishing as well as better trained employees in the last few years have greatly improved the product over the original and simplified the control of the process.

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Types of Wire Insulated

AS mentioned in the first few paragraphs the trend in telephone cable construction has been toward finer and finer wire. The insulating equipment and process described is particularly well adapted to apply coatings of pulp from six to ten mils in thickness to gauges of wire between 19 and 30 gauge. Changes in the mechanical equipment would be necessary for handling wire finer than 30 gauge or wire heavier than 19 gauge. As little demand for these gauges exists in exchange area telephone circuits, no attempt has been made to adapt the machine to these sizes. However, use of the process can be extended quite widely both in the type of materials used for insulating and kind of wire covered, if demand for such extension exists. So far the development of this insulation process has made it possible to produce wires with insulations so thin that 1515 pair cables of 24 gauge wire and 2121 pair cables of 26 gauge wire are being commercially made available to the telephone companies with no increase in external diameter of the lead sheath now used. If it should be required 3030 pair cables of 28 gauge wire could be made available within this same limiting diameter. More effective use of existing underground ducts can therefore be made, eliminating possible large expenditures by the telephone companies for such facilities.

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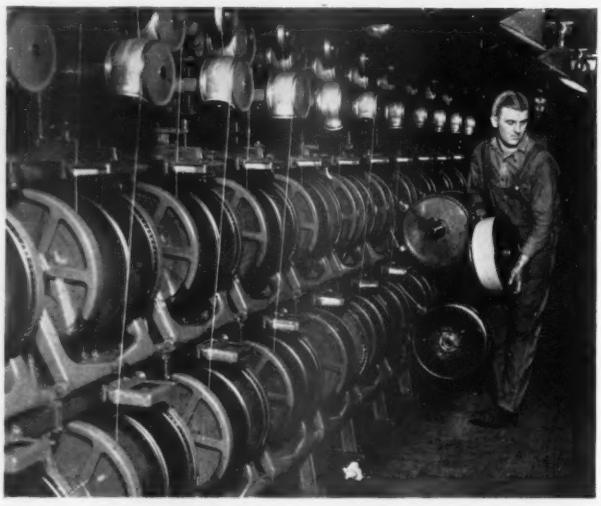

Fig. 9. Insulated Wire Takeup.

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IN conclusion it may be said that a method has been developed for economically manufacturing insulated wire for telephone exchange area cable by making the paper on the wire. Further, this method has made it possible to increase the number of wires in a full sized cable by 250% over the number in use in 1914. It is expected that still further uses will be found for the process in the replacement of other types of insulation.

NATIONAL METAL CONGRESS AND EXPOSITION

THE INTERNATIONAL AMPHITHEATRE, CHICAGO, ILL., OCTOBER 23-28, 1939

THIS exposition is staged and sponsored each year by the American Society for Metals, in co-operation with The American Welding Society, the Wire Association, the Institute of Metals and the Iron and Steel Divisions of the American Institute of Mining and Metallurgical Engineers, and the Iron and Steel and Machine Shop Practice Divisions of the American Society of Mechanical Engineers.

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THESE five national societies hold meetings during the Congress, but these are so arranged that they do not interfere with attendance at the Exposition. Meeting rooms are conveniently located for attending the Exposition.

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IT is impossible to list here all the products shown at the Metal Show. Here, however, is a partial list: raw, semi-finished and finished ferrous and non-ferrous products, supplies and equipment for heat treating, welding and cutting apparatus, machinery and accessories, inspection and testing equipment, forgings, insulating materials, wire, wire products, wire drawing equipment and accessories, precision tools and instruments, refractories, abrasives, rust proofing compounds, and many other products and processes.

Make Your Plans Now To Attend The National Metal Congress and The Wire Association Technical Sessions — All Engaged In The Production, Fabrication and Sale of Wire and Wire Products Are Invited.

Outstanding Personalities of the Wire Industry

Edmond P. Severns,
Vice President in Charge of Sales, Continental Steel Corp., Kokomo, Ind.

EDMOND P. SEVERNS, general manager of sheet sales of the Continental Steel Corporation, Kokomo, Indiana, since February, 1939, has been elected vice-president in charge of sales, a new position. The election was announced by Mr. D. A. Williams, president of the company.

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MR. SEVERNS has been engaged in the steel industry for 17 years, prior to which time he was in the sales department of the Prest-O-Lite Co., Indianapolis, Indiana. In May, 1922, he was named assistant to the sales manager, of the Chapman-Price Steel Company, Indianapolis, and became sales manager of this concern in 1923, following the death of Mr. L. H. Price.

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IN 1928, one year after the Chapman-Price Steel Co., merged with the Kokomo Steel & Wire Company, Kokomo, Indiana, and The Superior Sheet Steel Company, Canton, Ohio, to form the Continental Steel Corporation Mr. Severns became sales manager of the sheet division for the Kokomo and Indianapolis plants. He continued in this capacity until February, 1939 when he was named general manager of sheet sales for the entire corporation. Mr. Severns is 42 years old.

Bill Childs Retires From Continental Steel

WITH the retirement from active service of William H. Childs, the steel industry will miss one of its best-loved personalities. His resignation as sales manager of the wire division of the Continental Steel Corporation takes effect October 1.

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THOUGH only 58, Bill Childs is one of the pioneers of the age of steel. He played a prominent part in building up the fence and wire industry. He was only 18 when he went to work for the old Page Fence Co. In the forty years since then he has held positions of ever-increasing responsibility, culminating with his appointment by Continental at the beginning of 1930.

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LONG active in the various organizations of the trade and industry, Mr. Childs is well known for his constructive counsel and stabilizing influence. His simple, direct manner, as well as his notable courtesy and good nature, have won him a wide personal friendship. In sales management, he distinguished himself by policies that were sound and progressive.

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WITHDRAWING from active participation in the steel business, Mr. Childs plans to pursue some of his personal interests, including his hobby of expert photography. He will live in his home at Adrian, Michigan, where he spent his early years and at one time was secretary and sales manager for a fence company, and at his winter home in Fort Lauderdale, Florida.

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Victor O. Allen, Technical Director, Wilbur B. Driver Co., Newark, N. J.

VICTOR O. ALLEN has been named Technical Director of the Wilbur B. Driver Company, Newark, New Jersey. For the past five years Mr. Allen has been associated with the Radio Corporation as consulting and research engineer.

Mayo D. Hersey,
Research Director, Morgan Construction Co., Worcester, Mass.

MAYO D. HERSEY, who has joined the staff of the Morgan Construction Company, Worcester, Massachusetts, as Research Director, was for fifteen years connected with the National Bureau of Standards at Washington, D. C. He organized the Aeronautic Instruments Section and later the Friction and Lubrication Section of the Bureau.

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MR. HERSEY served as associate professor of properties of matter at the Massachusetts Institute of Technology, also as physicist in charge of the physical laboratory at the Pittsburgh Experiment Station, U. S. Bureau of Mines, and more recently as head of the test department in the Kingsbury Machine Works, Inc., at Philadelphia.

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HE is a fellow of the American Society of Mechanical Engineers and a member of the Research Committee of that Society. Mr. Hersey is the author of "Theory of Lubrication."

EDUCATED at King Edward VI School, England, F. & M. Academy, and F. & M. College. He started with Carnegie Steel Company during college vacation.

(*Please turn to Page 582*)

Outstanding Personalities of the Wire Industry

W. A. Ross, President, Columbia Steel Co.

WILLIAM A. ROSS has been elected president of Columbia Steel Co., a subsidiary of U. S. Steel Corporation, on Sept 1st. Mr. Ross succeeds Ambrose N. Diehl who resigned because of ill health and who has headed the steel company since 1932.

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THE new president of Columbia Steel has been connected with the steel industry since 1895, when he went to work for the old Washburn Moen Manufacturing Co., as an office boy. In 1899 Washburn Moen was acquired by the American Steel & Wire Co., and Mr. Ross served the new firm as bill clerk and cashier. In 1911 the west coast holding of American Steel & Wire Co., became the Pacific Coast department of the United States Steel Products Co., a subsidiary of the U. S. Steel Corporation.

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UPON this new consolidation Mr. Ross was appointed assistant treasurer and then assistant to the vice president of the products company. In 1930 Columbia Steel Corporation was acquired by the U. S. Steel Corporation. The Pacific Coast department of the United States Steel Products Co. was then consolidated with the new enterprise under the name of Columbia Steel Co. with Mr. Ross serving as vice president and treasurer.

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Wayne Mendell Riehle Testing Machines

WAYNE MENDELL has been appointed to supervise the sales activities of the Riehle Testing Machine Division and other divisions of American Machines and Metals, Inc., in the Chicago area, with headquarters at 35 East Wacker Drive. Mr. Mendell was formerly president of the Fletcher Machinery Corporation, and vice-president and general sales manager of U. S. Hoffman Machinery Corporation.

Revere Copper Appoints R. C. Dalzell Tech. Advisor to Baltimore Division

THE appointment of R. C. Dalzell as technical advisor to Revere's Baltimore Division, with headquarters at Baltimore, Md., was recently announced.

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MR. DALZELL graduated from Johns Hopkins University in 1927 with degree of Bachelor of Engineering in electrical engineering.

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HE then entered the Graduate Engineering School of Harvard University, 1927; received the degree of Master of Science in nonferrous metallurgy in 1928; received the degree of Doctor of Science in metallurgy, 1929. Metallurgical studies and research were conducted under Professors Albert Saveur and Arthur E. Wells.

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UPON completion of work at Harvard in 1929, Mr. Dalzell entered the Central Research Laboratory of the American Smelting & Refining Company at Perth Amboy, N. J., where he remained until 1931.

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UPON his resignation from the American Smelting & Refining Company in 1931, Mr. Dalzell was engaged by G. H. Clamer of the Ajax Metal Company, Philadelphia, for a period of one year on process development. Upon completion of his work there, he engaged in general metallurgical consulting work, at the same time representing Charles Eaglehard, Inc., in Maryland, Delaware and District of Columbia.

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FROM 1933 to 1937 Mr. Dalzell was employed by the American Oil Company, Baltimore, Md., resigning to come with Revere on September 15, 1937.

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J. P. Hoelzel, President, Pittsburgh Screw & Bolt

JOHN P. HOELZEL, vice president of the Pittsburgh Screw & Bolt Corporation, has been elected president, succeeding Charles R. Ferguson, who was elected chairman of the board. Mr. Ferguson succeeds John F. Miller, resigned, who will continue as a director and act as vice chairman. J. M. Yahres, executive vice president, was elected a director.

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Jack Breining, General Supt., Indian Steel & Wire Products, Tatanagar, B.N.R., India

TO the many friends of **Jack Breining** it will be interesting to know that in connection with his appointment as General Superintendent at the Indian Steel & Wire Products, Tatanagar, B.N.R., India, he arrived in Bombay June 18th after a quick and pleasant trip. After a couple of days sightseeing in Bombay and a few more in Calcutta, he went to Tatanagar, where a bungalow had been made ready for him.

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HE reports that the mill and equipment are rather better than he had anticipated, being comparable with one of the older American mills in good repair. Some of the practices need a good deal of revision, particularly galvanizing, nail cleaning, and drafting practice for small and medium gauges.

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JACK says that the rainy season started just as he arrived, a season which, by reason of both heat and humidity, is said to be hard on white men, but, seasoned by twenty-five years of Monessen, he finds the Indian climate "rather pleasant". His only complaint at the moment is that because of a general strike at the mill, which spread from a small dispute in the machine shop, he is not busy enough.

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Avery C. Adams, Vice President, Sales, U. S. Steel Corp. of Delaware

ELECTION of Avery C. Adams as vice president in charge of

(*Please turn to Page 616*)

Exports and Imports of Wire

Exports of Iron and Steel Wire Products in July 1939 and July 1938
(In gross tons)

	JULY 1939	JUNE 1939	JULY 1938
Wire rods	3,706	3,564	1,312
Strip steel	4,877	5,083	2,712
Plain, black or galvanized iron or steel wire	4,044	5,374	5,667
Barbed wire and woven wire fencing	4,791	5,139	4,054
Woven wire screen cloth	125	149	93
Wire rope	319	212	204
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	573	1,059	539
Wire nails	1,890	2,035	2,264
Tacks	18	30	20
Other nails, including staples	434	482	555
Bolts, machine screws, nuts, rivets and washers	630	719	643
Total, these 11 classifications	21,407	23,846	18,063

Imports of Iron and Steel Wire Into the United States
(In gross tons)

Concrete Reinforcement bars	20	399	89
Hollow bar and drill steel	206	96	47
Wire rods	727	782	278
Barbed wire	1,612	1,883	692
Round iron and steel wire	97	128	107
Telephone and telegraph wire	.....	.....	.....
Flat wire and strip steel	238	261	168
Wire rope and strand	141	116	99
Other wire	82	125	97
Hoops and bands	1,556	1,849	1,040
Nails, tacks and staples	838	735	626
Bolts, nuts and rivets	3	3	12
Total, these 12 classifications	5,520	6,377	3,255

Exports of Insulated Wire and Cable, July 1939

	Foreign		To U. S. Possessions	
	Pounds	Dollars	Pounds	Dollars
Rubber covered wire	310,158	$ 71,560	162,029	$ 32,036
Weatherproof wire	135,160	18,829	41,137	5,814
Other insulated copper wire	426,771	93,344	224,502	40,412
Nickel-chrome electric resistance wire	55,182	51,213	.....	.....
Total, these 4 classifications	927,271	$234,946	427,668	$ 78,262

Exports

AT 163,598 gross tons exports of iron and steel products (scrap excepted) from the United States during July were smaller than in June when 189,968 tons of these materials were shipped to foreign buyers. A year ago—in July, 1938—this trade had amounted to only 137,276 tons valued at $9,832,797. The July, 1939 exports were valued at $12,141,748 while the June trade had been valued at $13,789,887.

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JULY imports, again excepting scrap, amounted to 27,516 tons valued at $1,285,390 against June receipts of 30,050 tons valued at $1,487,504 — both being much greater than the 14,094-ton trade of July, 1938, which had been valued at $955,215.

Scrap Exports Lower

ONLY 350,066 tons of scrap valued at $5,079,577 was exported in July—these figures comparing with the 397,321 tons valued at $5,692,273 shipped in June. The trade in July, 1938, amounted to only 126,423 tons valued at $1,667,487.

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Tin Plate Again Lead Export Trade

IN both tonnage and value tin plate — 22,264 tons valued at $2,316,946—was the principal product in the July trade. As usual shipments were made to a large number of countries among which Canada (3,716 tons), the Netherlands (3,496 tons), Brazil (3,047 tons), and Belgium (1,247 tons) were the chief. At 19,519 tons the trade in non-alloy black steel sheets was also well maintained with the United Kingdom (4,963 tons), Canada (4,039 tons), Australia (1,166 tons), and Brazil (1,048 tons) the leading markets. The trade in non-fabricated, non-alloy plates amounted to 13,930 tons including 1,266 tons exported to Canada, 1,244 tons sent to Finland, and 1,217 tons shipped to Mozambiue. Exports of plain structural shapes—10,078 tons—were featured by the 5,812 tons sent to Canada and the 887 tons marked for China, while 5,988 tons of the 9,672-ton total of non-alloy ingots shipped went to Japan.

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Canada Again Leading Purchaser

CANADA with a total of 29,344 tons was again the United States' leading market for iron and steel products. Included in the July shipments to this purchaser were 5,812 tons of plain structural shapes, 4,039 tons of non-alloy black steel sheets, 3,716 tons of tin plate, and 2,010 tons of non-alloy hot rolled strip. China was the month's second market with a total of 11,199 tons including 3,876 tons of non-alloy "other" bars, 1,847 tons of wire rods, and 1,295 tons of pig iron. The trade with Brazil totaled 9,902 tons with tin plate, 3,047 tons, and barbed wire, 1,540 tons, the leading items, while of the 9,587 tons sent to the Philippine Islands 1,956 tons was galvanized steel sheets and 1,286 tons was concrete reinforcement bars. Tin plate featured the trade with the Netherlands and non-alloy ingots that with Japan.

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Import Trade Declines

IMPORTS of iron and steel into the United States declined from 30,050 tons in June to 27,516 tons in July. Pig iron was, in point of tonnage, the principal product received—the 6,189-ton total including 3,816 tons from British India and 1,636 tons from the Netherlands. Next was structural shapes—4,867 tons—3,999 tons of which came from Belgium and 855 tons from France. Canada was the

(*Please turn to Page 622*)

Progress and Trends of The Wire Industry

By Frederick A. Westphal,
Superintendent of Wire Mills,
Sheffield Steel Corporation, Kansas City, Missouri.
President of The Wire Association

IN spite of these perplexing wartimes that are facing us today, we can, nevertheless, visualize the future with confidence for progress to be made in the wire industry pertaining to ferrous, non-ferrous and alloy steel wires. Operating men, metallurgists and engineers are constantly striving to seek better control of manufacture and better quality of finished product, whether it be for finished items of wire products immediately ready for ultimate consumption or wire to be used as manufacturers wire to become integral parts of a finished product, such as in the automotive, wire rope or bed spring industries. We may briefly discuss the following five points:—

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(1) STEEL making departments are becoming more customer conscious on the finished results that their steel is headed for. With cooperative action on their part with the research, metallurgical and metallographical departments, definite strides of progress towards solving intricate problems are repeatedly in evidence, thereby clearly demonstrating complete reliability.

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(2) BILLET and rod mills are now built with auxiliary handling equipment that roll 600 to 900 pound coils of finished rods that allows larger increment loads to be subsequently processed. This should reflect favorably on yields and conversion costs, bearing in mind vast capital expenditures for this accomplishment. This progressive action in leading towards a goal of 2000 to 3000 pound continuous-length coils of rods.

(3) ELECTROLYTICAL cleaning of batches of rods and wire with catalytical chemical agents is being accomplished that tend towards positive, thorough and rapid cleaning of rods and wire. Furthermore, rapid dispatch of larger increment loads to "straight-line" cleaning tanks, that are equipped with power-driven agitators to accelerate the chemical reaction of cleaning time, combined with "flash baking" is a new lay-out and method enabling rods or wire "from stock" or from the rod mills to be prepared and delivered to wire drawing machines immediately ready for drawing wire in approximately thirty minutes, compared to the average of six to ten hours now mostly used on the same comparable operation. Time, quality of cleaning and reduced costs, again bearing in mind capital expenditures, are the factors that favorably enter into these two new progressive methods of cleaning rods and wire.

FREDERICK A. WESTPHAL
Superintendent of Wire Mills,
Sheffield Steel Corp., Kansas City, Mo.
President, The Wire Association

Born Holyoke, Mass., 1895. Graduate U. S. Naval Academy. Four years with American Steel & Wire Co. In 1922 Assistant Superintendent Rod and Wire Works, Jones & Laughlin Steel Corp., Aliquippa, Pa. In 1928 Superintendent of Wire Mills, Sheffield Steel Corp., Kansas City, Mo. During World War served as Officer Sixth Field Artillery — severely wounded in action — twice cited and decorated for gallantry in action and meritorious services.

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(4) GREATLY improved machinery design of continuous wire drawing equipment combined with the use of Tungsten-Carbide dies, and moreover, with the progressive thought and action for increasing the speed of drawing on nearly all types and grades of ferrous, non-ferrous and alloy wires, it means that these elements have greatly contributed for solving certain problems for better achievement of production and quality that are continually facing operating men.

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(5) WITH the advancements already developed in material handling systems, conveyors, cranes and power-driven tractors, we should anticipate progress in future engineering and construction programs in this direction. With a vision towards the more modernistic and streamline production methods plus the increasing size of increment loads, and therefore, to start from larger heats of steel and non-ferrous metals, larger ingots, heavier weight billets for finishing heavier weight continuous-length coils of rods and wire, it is entirely feasible that progress will be routing individual units of metals to finished products on an assembly-line basis more so than is accomplished today.

The Outlook For 1940

By Kenneth B. Lewis,
Consulting Wire Mill Engineer,
Worcester, Mass.

TECHNICAL progress in wire manufacture this year has been rather general throughout the primary processes and the drawing room, but considerably less marked in the fabricating end.

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IN the cleaning house the trend toward straight line is unchecked. More and more mills are finding that a straight line is the shortest distance between the rod yard and the drawing room. Two general types of crane are in service over the tubs, each having its own advantages. The light, high speed gantry is probably more dependable, and faster, though its lack of trolley motion requires either extra labor or extra equipment to get the loads on and off the hook. The travelling crane, heavier, slower, and more difficult to service, is more flexible at the ends of the line, as it can pick up and discharge from areas rather than spots.

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MECHANICAL agitation of rods in the acid, an old idea never thoroughly explored, is getting another play under the most favorable circumstances. The submerged flame as a substitute for steam heating of acid baths has undergone further development and further trial, though no very definite word of its value in neutral hands is yet available.

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THE flash baker holds its place as the most radical, successful, and generally accepted innovation in the cleaning house. Several of this year's installations have been indirect fired, a useful precautionary measure where either a high sulphur fuel or small process wire is encountered. By no means the least of the flash baker's advantages is its tremendous simplification of the problems of layout and handling.

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IN the drawing room the old group-driven wire blocks are definitely on the run before individually motor driven units and continuous machines. The Morgan-Connor machine, which pioneered in the continuous field before the days of carbide dies, continues as a group-driven machine but is usually equipped with clutches to permit "decumulating" and non-stop drawing of welded coils. The Vaughn machine, non-twisting, with automatic speed compensation, is too well established to need more than passing mention. With a more effective cooling of its drums it is now doing excellent work in the field of the patented products.

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THE Aetna-Standard unit machine, the latest entrant into this field, claims to combine the best features of both its rivals. It secures the greatest degree of flexibility by assembling independent units into a machine to which units may be added, or from which they can be subtracted, as the run of work may require. The units may run as an accumulating machine, with twist, through hand-set rheostats, or, if non-stop operation from welded rod is desired, an automatic compensation can be cut in, and accumulations held at a predetermined level.

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IN galvanizing, various refinements in the hot process enable hot-coated wire to battle successfully with the beautiful (and, it is whispered, rather costly) product of the electro-installations. Both may ultimately be menaced by a new product, aluminum-coated wire. The leading technique, which is understood to be in process of exploration in a pilot plant, involves the saturation of the steel with hydrogen at a very high temperature; the hydrogen evolved upon contact with the bath reduces all oxides and promotes a clean bond. A few special applications await the perfection of the technique; how far beyond them the field extends is problematic.

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POT annealing has, in recent years, become a closely controlled operation, both as to surface and as to structure. The past year has seen the replacement of a number of coal fired heavy-pot installations with one of the modern types. The bell type, taken over from tin mill practice several years ago, and the pit type with stainless sheet metal pots, are equally effective, each with its strong and weak points. Local conditions usually govern the choice, and the same remark applies to the heating medium. Electricity has lost its advantages in cleanliness and accuracy of control, and must win on its cost or give way to fuel.

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THE impact of war on the wire industry has as yet been felt only in a general quickening of the pace, almost wholly in immediate origin. What it may do to those war-babies of the wire mill, barb wire and rope, remains to be seen. Everybody with barb fence ma-

chines is dusting them off, and refusing all offers to buy them, but no war ever follows closely the pattern of previous wars. In the last war the allied forces, to whom we could ship, were on the defensive, and it is the defender who needs barb wire. This war may take such a turn that no army which we could supply will be on the defensive in large-scale trench warfare. If Holland and Belgium succeed in remaining neutral, and the wire mills of northern France are spared, we may never ship a pound of barb wire. Foreign demand since the start of this war has been for rods and billets.

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A SIMILAR situation may affect our plans in wire rope. The allies anti-submarine campaign in the last war involved anchored mines and huge nets. Now, it is rumored, the new strategy revolves around audio-detectors, airplane spotting, and depth charges. In the last war the objective was to keep the subs from getting out of port or getting back. Now they are already out, and must be hunted down one by one.

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Present Trend In Wire Industry

By B. L. McCarthy,
Chief Metallurgist,
Wickwire Spencer Steel Co., Buffalo, N. Y.

THE trend towards higher drawing speeds continues in the wire industry and speeds up to 2000 ft. per minute are now being employed and the use of higher speeds is becoming more universal. High speed operation has placed an extra demand on the materials used as lubricants and indications are that lubrication will receive considerable attention in the near future.

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THE use of Bakers wherein the air is moved about the stock at high velocity, is now well established as good practices and baking times of 5 to 8 minutes for low carbon and 10 to 12 for high carbon are replacing the old 6 to 8 hour baking time, as this new equipment is being added.

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THE development of specifications for spring wire by the American Society for Testing Material constitutes a step in the direction of standardization of spring wire and while the specifications are general in nature they tend to stabilize wire specifications generally.

BENJAMIN LEWIS McCARTHY

Born in Lockport, New York, in 1895. In 1913 was employed as Assistant Chemist by Simonds Saw and Steel Co. In 1916 was employed by Wickwire Steel Co., now known as Wickwire Spencer Steel Co., as Assistant Chief Chemist. Three years later was promoted to Chief Chemist and Metallurgist. Now in charge of the Chemical and Metallurgical Laboratories and directs research and special investigation into the Chemistry and Metallurgy of steel, steel wire and wire products. Member of the Wire Association, The American Society for Testing Materials, and the American Society for Metals. Awarded the Wire Association Medal for the most meritorious paper on wire manufacture or fabrication during the years 1935 and 1937.

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THE microscope is being used more extensively in the wire industry as a guide for heat treatments and such terms as Grain Size, Spheroidize - Anneal, Fine Pearlite, etc., which require microscopic examination to establish them are becoming more common each day. As a result of this, wire with higher tensile strength and greater ductility is being produced because scientific studies enables the wire-mill technical man to better control the variables.

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IN general, the application of scientific and engineering knowledge has raised the standards of quality of wire being produced and indications are that this development will continue.

The Discussions at The Wire Association Meetings Will Be Published in Detail in the January, 1940 Issue of Wire and Wire Products.

✦ These Discussions — In Connection With the Published ✦
✦ Papers Will Contain Information of Great Value To All ✦
✦ Wire Production Men — Be Sure To Secure A Copy. ✦

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Sheffield Steel Corp.,
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Steel Co. of Canada, Ltd.,
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F. A. Westphal, Superintendent, Wire Mills,
Sheffield Steel Corp., Kansas City, Mo.

✦ ✦ ✦

THE Wire Association is a non-profit organization of wire mill executives, superintendents and foremen. It also includes plant engineers, traffic men, and all others engaged in the production of cold drawn bars, rods, wire, strip, insulated wire and cable, and the manufacture and fabrication of finished wire products, including cold headed, extruded and other cold worked metal products.

THERE are separate divisions for all the separate major interests in the wire industry, steel, iron, brass, copper, alloy, and precious metals, together with divisions relating to drawing, cold working, cold heading, extruding, fabricating, forming, spring making, wire cloth, wire rope, bare and covered electric wire and cable and all other forms of wire and wire products.

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PURPOSES

ITS specific purpose is to improve production methods and afford a clearing house for ideas on management problems, technical problems, and research work in all phases of practical wire drawing and wire working, and to develop and maintain friendly relations among the members.

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ACTIVITIES:

The Association functions along the following lines:

1. The use of the Association headquarters as a central clearing house for information and data of all kinds which may be of interest to members.
2. The exchange of ideas on processes of production including machinery, technical processes, etc.
3. The establishment and maintenance of friendly relations among the members of the association and the development of sectional and national meetings to discuss matters of mutual interest.
4. Studies of production methods and analysis of production costs.
5. Developments in the use of new materials and new applications of existing materials and by-products.
6. Research and collection of information on personnel management, including such factors as labor turnover, seasonal changes in the demand for employees, wage scales, etc.
7. Standardization and simplification as a means for the effective elimination of waste.
8. Such other subjects as may be determined upon.

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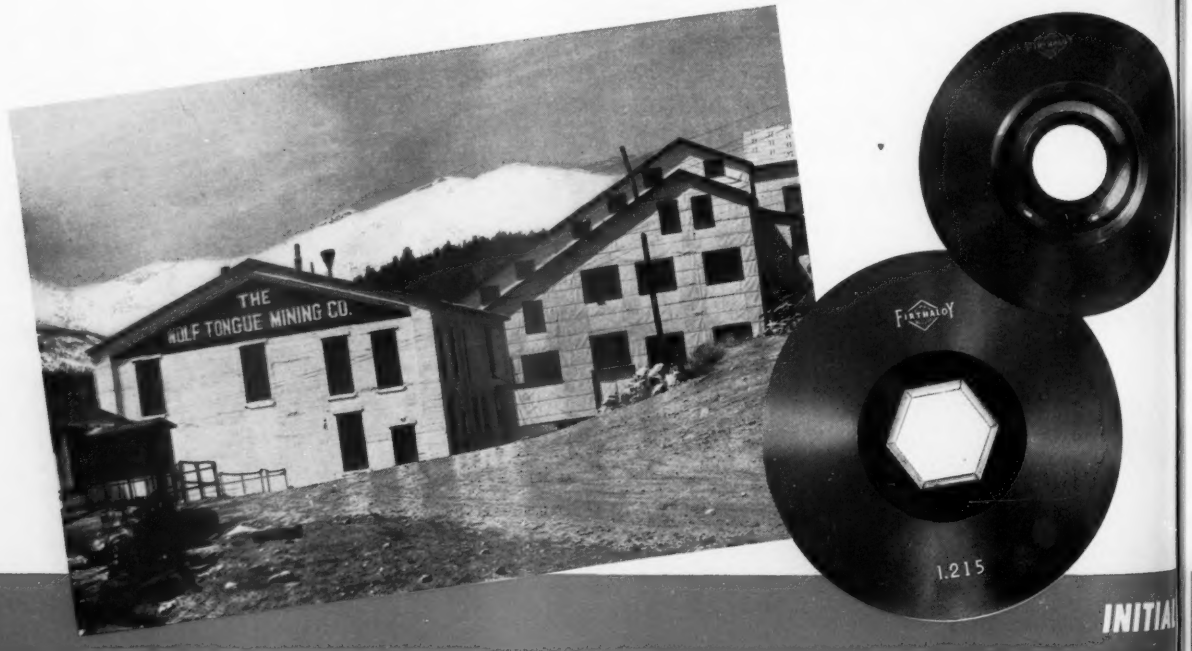
FROM the Tungsten ore, supplied by our own mines, to the finished die, every operation in the manufacture of FIRTHALOY Tungsten Carbide Dies is controlled by Firth-Sterling. A sufficient domestic supply of Tungsten, with expert selection and milling of the Tungsten, is assured, regardless of Foreign complications, through ownership of Wolf Tongue Mining Company of Boulder—Producers of American Tungsten since 1905.

Increased manufacturing facilities in the new plant at McKeesport, Penna., also assure an adequate supply of the uniformly high quality dies which have led to the widespread adoption of FIRTHALOY, in plants where high production, accuracy and long die life are desired.



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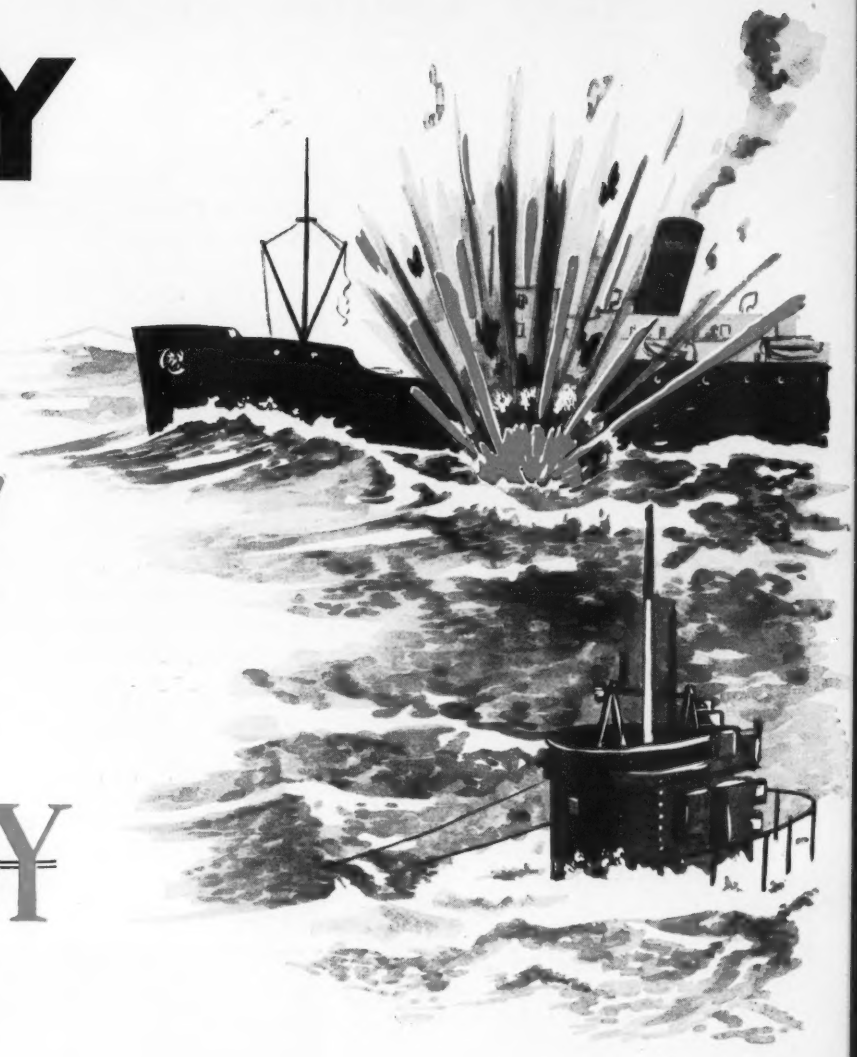

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COST MAY BE HIGH BUT **FIRTHALOY** *DIES ARE THE BEST IN THE LONG RUN*

High Lights of the Convention Program

This year's meeting will be unusual in that several speakers will present original researches and present demonstrations in connection with their presentations. ✦ ✦ ✦ ✦ ✦ ✦

IN connection with the papers to be presented at the Annual Wire Association Meeting at Chicago in October, the paper originally scheduled by George P. Nelson, Metallurgist of the L. A. Young Spring & Wire Company, under the title of "Elasticity of Spring Wire", will not be available as the author found it quite impossible to complete the necessary work in time, due to other demands on his time.

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IN addition to the papers scheduled on the program as originally published, there is an another paper entitled "Engineering of Continuous Strand Equipment" by Rodman R. Tatnall, Metallurgist, Wickwire Spencer Steel Company, Worcester, Mass. This paper is published elsewhere in this issue of "WIRE & WIRE PRODUCTS".

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BRIEF descriptions follow of the activities, lectures, motion pictures and papers to be presented at the meeting, which are not published in this issue of "WIRE & WIRE PRODUCTS" in detail.

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Plant Inspections

PERHAPS the two most interesting events scheduled will be the plant inspection at the Hawthorne Works of the Western Electric Company on the afternoon of Tuesday, October 24, and the visit to the new Republic wire mill on the afternoon of Thursday, October 26.

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RESERVATIONS for these plant visitations should be made at the Wire Association registration desk in the main lobby of the hotel immediately upon arrival. Transportation will be by busses, for which there will be a small charge. The busses will leave the hotel promptly at 1:30 P. M. on Tuesday and Thursday afternoons in order to reach the plants in time to permit of a thorough visit.

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ALIENS must register three weeks in advance in order to have their names submitted for permission to go on these trips. Such registration to be made with the Secretary of the Wire Association.

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The Mordica Memorial Lecture

THE **Mordica Memorial Lecture** will be presented by **Dr. S. A. Braley**, Chief Metallurgical Field Engineer, Rod & Wire Division, Pittsburgh Steel Company, Pittsburgh, Pa., and the subject will be "A Correlation of the Factors and Effects of Cold Drawing of Wire Rods".

S. A. BRALEY

Received A. B. degree at Morningside College in 1913, A. M., University of Illincis 1915, PhD., University of Illinois 1917. Instructor and Assistant Professor of Chemistry, University of Illinois 1917-1927. Pittsburgh Steel Company Fellowship at Mellon Institute of Industrial Research 1927 to date. Member, American Society for Metals, Wire Association.

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IT is expected that the lecture will take approximately one hour to deliver and while it is usually not considered that papers or lectures of this type are open for discussion, Dr. Braley has stated that in this instance he hopes that there will be discussion of the lecture at the meeting, because he finds that there is usually more good obtained from such a discussion than from simply presenting the paper and stopping there.

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THE lecture will be delivered the afternoon of Wednesday, October 25th at the Wire Association annual meeting.

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The Annual Wire Association Luncheon

THE guest speaker at this year's luncheon will be **Major-General Joseph O. Mauborgne, Chief Signal Officer of the United States Army.** Since the Signal Corps is charged with the purchasing of practically all wire for military purposes, General Mauborgne's address—dealing as it does with pertinent questions of supply—will undoubtedly be of interest to all members both ferrous and nonferrous.

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IN this connection, members are at liberty to invite guests and ladies are welcome. Members and guests of other societies partici-

pating in the National Metal Congress are also invited to attend. Tickets for the luncheon will be obtained at the registration desk in the Hotel Congress.

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Smoker

THIS year's Smoker is once more under the direction of Mr. A. R. Zapp, Manager of the Firthaloy Division of Firth-Sterling Steel Company, and a contract has been made for the definite employment of particular acts. It is felt that no criticism will be offered about the show presented this year. It will be well worth the money.

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Association Headquarters

AS usual the Wire Association will maintain a headquarters suite of rooms in the hotel for the purpose of enabling members to make appointments and to hold "get-together" sessions at such times as they are not at the meetings. These rooms will be open from 9:00 A. M. to 11:00 P. M. from Monday to Thursday, and on Friday from 9:00 A. M. to 6:00 P. M., during the Convention week. All registered members and guests are welcome. The room numbers will be displayed at the registration booth in the hotel.

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Boulder Dam and the World's Outstanding Transmission Lines

By Dr. Donald M. Simmons,
Chief Engineer, General Cable Corp., New York, New York

THERE will be no paper presented in connection with this lecture because the fundamental purpose is to give a pictorial presentation, through moving pictures, of Boulder Dam and the 287,000 volt transmission lines to take the bulk of the power to Los Angeles.

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THE general sequence of the lecture follows:—

A brief talk about the functions of the various parts of Boulder Dam, such as the intake towers, outlet works, penstocks, power plants, spillway, etc. This is followed by a brief description of the outstanding features of the transmission lines accompanied by two reels of movies taking about twenty minutes showing:

(1) The construction of Boulder Dam.
(2) The erection of the transmission line towers.
(3) The manufacture of the cable in our Los Angeles Plant.
(4) The erection of the cable on the transmission lines.

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SINCE the movies were taken before the completion of the dam and the transmission lines, the speaker will follow the picture with a set of slides, giving typical and rather beautiful views of the completed dam and transmission lines.

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Atmospheric Annealing of Steel Wire

By Dr. A. Allan Bates,
Manager, Chemical and Metallurgical Division
and
John Gier,
Associate Metallurgist, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

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THOSE who attended the Regional Meeting of the Wire Association in Pittsburgh will recall that Mr. Gier and Dr. Bates put on a little show using apparatus devised by Mr. Gier which illustrated how readily a steel may be changed at elevated temperatures by changes in the chemistry of the furnace atmospheres.

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A SIMILAR demonstration on a somewhat larger scale will be given at the October meeting and should be most interesting to all present.

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Characteristics of Mild Steel Welding

By J. C. Joublanc,
Technical Director, Harnischfeger Corp., Milwaukee, Wisconsin

THE experimental investigations in connection with this paper took a somewhat longer time then was estimated by the author and consequently the paper presenting the results of the experimental work, while not ready for publication at the time this Convention number of "WIRE & WIRE PRODUCTS" goes to press, will be ready in time for presentation at the Convention and will be published in "WIRE & WIRE PRODUCTS" at a later date.

✦ ✦ ✦

THE author is investigating and attempting to outline the relations between certain chemical or structural properties of wire and their welding characteristics. The work is being done along original lines and the information presented will be new and not simply a repetition of what has already been told.

✦ ✦ ✦

Manufacture of Swedish Steel Wire

A SOUND film with this title will be exhibited as a part of the Wire Association meeting in Chicago in October. The entire presentation is in English, the voice being that of Mr. J. Clemenger, the regular commentator for Pathe News.

✦ ✦ ✦

SINCE a considerable percentage of the high grade music wire and valve spring wire is made from Swedish material it is thought that this motion picture will be of great interest to a great many of our members.

✦ ✦ ✦

THE picture shows one of the oldest and largest steel mills in Sweden, Uddeholm's a/b,—the back-ground of the people making the rods and how the rods are made from the mine to the finished coil.

✦ ✦ ✦

THE spectator is first acquainted with the extensive holdings of this two hundred and seventy year old company. He is whisked by plane over the beautiful Swedish country-side to the various ore mines, hydro-electric plants and steel mills, owned by the Uddeholm Company. He glimpses the thousands of acres of forestland which produce charcoal so essential to

THE WIRE ASSOCIATION ANNUAL MEDAL AWARDS

For the Most Meritorious Paper on Wire Manufacture Or Fabrication During the Year

1934 — EDWARD J. P. FISHER
Metallurgist, Keystone Steel & Wire Co., Peoria, Ill.
Title of Paper: "COLD DRAWN STEEL SPRING WIRE"

1935 — BENJAMIN LEWIS McCARTHY
Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper: "GRAIN SIZE AND ITS INFLUENCE ON THE MANUFACTURE OF STEEL WIRE"

1936 — ROBERT NOTVEST
Chief Engineer, Welding Division, J. D. Adams Mfg. Co., Indianapolis, Ind.
Title of Paper: "STEEL FOR ARC WELDING ELECTRODES"

1937 — BENJAMIN LEWIS McCARTHY
Chief Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper: "ABNORMAL GRAIN GROWTH AND THE ANNEALING OF LOW CARBON STEEL WIRE"

1938 — WALTER R. BLOXDORF
Metallurgist, The MacWhyte Co., Kenosha, Wis.
Title of Paper: "WIRE ROPE"

✦ ✦ ✦

HONORABLE MENTIONS

1935 — L. D. SEYMOUR
Metallurgist, Rod and Wire Dept., Youngstown Sheet & Tube Co., Youngstown, O.
Title of Paper: "COLD HEADING WIRE"

R. A. SCHATZEL
Superintendent, General Research Laboratories, General Cable Corp., Rome, N. Y.
Title of Paper: "HARD AND SOFT COPPER WIRE"

1936 — BENJAMIN LEWIS McCARTHY
Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper: "PLASTIC DEFORMATION IN WIRE DRAWING"

1937 — ROBERT W. SANDELIN
Metallurgist, Atlantic Steel Co., Atlanta, Ga.
Title of Paper: "A METALLURGICAL STUDY OF THE FACTORS AFFECTING THE QUALITY OF GALVANIZING"

ALLAN B. DOVE
Chemical Engineer, Canada Works,
The Steel Company of Canada, Ltd., Hamilton, Ont., Canada.
Title of Paper: "A. C. ELECTRO PICKLING—A BETTER METHOD OF PICKLING"

1938 — RODMAN R. TATNALL
Metallurgist, Morgan Works, Wickwire Spencer Steel Co., Worcester, Mass.
Title of Paper: "RESILIENCE OF SPRINGS"

JOSEPH A. DOYLE
Vice President, W. S. Rockwell Co., New York, N. Y.
Title of Paper: "HEATING COPPER WIRE BARS"

fine steel making, as well as lumber, woodpulp and other forest products. The full meaning of Uddeholm's slogan—"from mine to finished bar"—is brought home to the spectator when he sees company-owned railroads and ocean-going steamers that convey Uddeholm's steels to the four corners of the earth.

✦ ✦ ✦

THE audience is made to realize what an important part the "human equation" occupies in Uddeholm's formula for superior steels. It is the company's contention that a happy, satisfied worker is an essential to the successful production of high quality steels as are the raw materials and finest equipment. To this end, the film shows the types of comfortable homes, each with its own flower and vegetable garden, wherein the majority of Uddeholm Company's 10,000 employees live, **as their own landlords**, thanks to the financial assistance given them by the Company.

✦ ✦ ✦

THE spectator is then introduced to the "Swedish way" of creating steel, from the careful production of the purest form of charcoal, to the production of pig iron and ferro-alloys in electric blast furnaces and the operation of acid open hearth furnaces, which are actually oversized crucibles, as well as electric furnace steel melting.

✦ ✦ ✦

UDDEHOLM'S laboratories, where tomorrow's steels are being created in miniature furnaces today, are shown. The many tests, operations and inspection methods Uddeholm steels must undergo, are stressed. Rolling of ingots, billets and rods, the piercing of tubes, interior and exterior grinding of tubes with automatic machinery, annealing and pickling, unfold in quick succession.

✦ ✦ ✦

ONE sees steel being made that approaches in value that of gold—selling for hundreds of dollars per pound, but which is in reality, a bargain when one considers its unusual properties, and the fact that there are some thousands of feet in a pound of steel.

❖ PROGRAM ❖

Wire Association Convention---1939

Chicago, Illinois, October 23-27. Association Headquarters — Hotel Congress

✦ ✦ ✦

The Exposition and Show of the National Metal Congress Will Be Open from Monday to Friday Inclusive, All Day and Every Evening During the Week Except Thursday Evening.

✦ ✦ ✦

Wire Association Headquarters at The Congress Hotel Will Be Open From 9:00 A. M. to 11:00 P. M. During the Entire Convention—Come and Get Acquainted!

✦ ✦ ✦

THERE WILL BE A REGISTRATION FEE OF $5.00 FOR THOSE ATTENDING THESE TECHNICAL SESSIONS AND INFORMAL MEETINGS

✦ ✦ ✦ ADMISSION WILL BE BY BADGE ONLY ✦ ✦ ✦

Open Discussions Will Be Held On the Papers Presented and These Discussions Will Be Published in the January, 1940, Issue of Wire and Wire Products.

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R. E. Brown, Publisher, "Wire and Wire Products", Stamford, Conn. Executive Secretary, The Wire Association (ex-officio)

ANNUAL DINNER—STAG SMOKER	LOCAL ARRANGEMENTS	MEETING ROOMS
A. R. ZAPP, Manager, Firthaloy Division, Firth-Sterling Steel Co., McKeesport, Pa.	E. J. HUBBARD, JR., Hubbard Spool Co., Chicago, Ill.	R. L. HAMAKER, Dist. Sales Manager, The Warner Company, New York, N. Y.
CHAIRMAN OF DINNER COMMITTEE	CHAIRMAN OF COMMITTEE	CHAIRMAN OF COMMITTEE

The Technical Sessions End Thursday in Order that Friday May Be Available To Make A Thorough Inspection of the National Metals Exposition.

MONDAY, OCTOBER 23	10:30 A. M.	12 NOON
	DIRECTORS' MEETING	PROGRAM COMMITTEE LUNCH

--- The Technical Sessions ---

(ALL RESEARCH PAPERS ARE PREPRINTED IN THE OCTOBER ISSUE OF WIRE AND WIRE PRODUCTS)

MONDAY, OCTOBER 23	**AFTERNOON SESSION — 2:30 P. M.**	
JOINT MEETING BOTH DIVISIONS	E. W. GUNDSTROM, Plant Manager, Rome Cable Corp., Rome, N. Y. Chairman of Meeting	
"CHARACTERISTICS OF MILD STEEL WELDING WIRE"	J. C. JOUBLANC, Technical Director Electrode Division	Harnischfeger Corporation, Milwaukee, Wisconsin
"SUBMERGED HEAT BY SUBMERGED COMBUSTION"	WALTER G. SEE, Sales and Service Manager	Submerged Combustion Co. of America, Hammond, Ind.
"BOULDER DAM AND THE WORLD'S OUTSTANDING TRANSMISSION LINES" A Lecture with Motion Pictures.	DR. DONALD M. SIMMONS, Chief Engineer	General Cable Corporation, New York, New York
TUESDAY, OCTOBER 24 Morning Session, 9:30 A. M. STEEL DIVISION	J. E. GIRVIN, Engineer in Charge, Wire and Cable Department, Canadian General Electric Co., Ltd. Peterborough, Canada Chairman of Meeting	
"ENGINEERING OF CONTINUOUS STRAND EQUIPMENT"	RODMAN R. TATNALL, Metallurgist	Wickwire Spencer Steel Co., Worcester, Mass.
"THE MANUFACTURE OF SWEDISH STEEL RODS"	A Motion Picture	Uddeholm Company of America New York, New York
TUESDAY, OCTOBER 24 MORNING SESSION, 9:30 A. M. NON-FERROUS DIVISION	WILLIAM A. SCHEUCH, Vice-President, Nassau Smelting and Refining Co., Tottenville, S. I., New York Chairman of Meeting	Members of The Institute of Metals Division of the A.I.M.M.E. are invited to attend this session of the Non-Ferrous Division without payment of The Wire Association registration fee.
"COATING WIRE WITH PAPER PULP"	J. S. LITTLE, Manufacturing Engineer	Western Electric Company Kearny, New Jersey
"THE BRAZING OF COPPER"	L. L. WYMAN, Research Engineer	General Electric Company Schenectady, New York
TUESDAY, OCTOBER 24 AFTERNOON SESSION, 1:30 P. M.	VISIT TO Hawthorne Works of The Western Electric Company	BY BOTH DIVISIONS
WEDNESDAY, OCTOBER 25 Morning Session, 9:30 A. M. STEEL DIVISION	B. L. McCARTHY, Chief Metallurgist, Wickwire Spencer Steel Corp., Buffalo, N. Y. Chairman of Meeting	
"ATMOSPHERIC ANNEALING OF STEEL WIRE"	DR. ALLAN BATES, Manager, Chemical and Metallurgical Division and JOHN GIER, Associate Metallurgist	Westinghouse Electric & Mfg. Co. East Pittsburgh, Pennsylvania

MAJOR GENERAL
JOSEPH O. MAUBORGNE,
Chief Signal Officer,
United States Army

MAJOR General Joseph O. Mauborgne, Chief Signal Officer of the United States Army was born in New York City, is a graduate of St. Francis Xavier College, and entered the Army in 1903 as a second lieutenant of infantry.

AFTER serving in the Philippines he went to the Fort Leavenworth Army Signal School, and upon graduation returned to the Philippines. Upon his return from the Philippines he was reassigned to the Signal School as acting commandant and trained practically all officers who became division, corps, and army signal officers of the A.E.F. By this time he had become one of the few officer-experts on cryptography and cryptanalysis.

IN 1917 he was responsible for Signal Corps training and for the development of all Army radio, wire, and cipher equipment, and for his outstanding service of these duties he was awarded a Distinguished Service Medal. He also developed the cylindrical cipher device which is still in use by the Army.

AS a result of his national prominence in radio, he represented the United States as technical advisor to the American delegations at the Interallied Radio Conference, Paris, 1919, the Interallied Technical Committee on Radio Communication, Paris, 1921, the Inter-American Committee on Electrical Communication, Mexico City, 1924, the International Telegraph Conference, Paris, 1925, and the International Radio Telegraph Conference, Washington, 1927.

HE has served successively as Signal Officer, Sixth Corps Area; in the Engineering and Research Division, Office of the Chief Signal Officer, Washington, in the adjustment of patent claims; as Commandant of the Signal Corps Laboratory; as Signal Officer, Panama Canal Department; as Director of the Signal Corps at Wright Field, Ohio, and as Chief Signal Officer of the Army since 1937.

HIS hobbies are painting, etching and the manufacture of fine hand made violins.

✦ ✦ ✦

"THE MANUFACTURE AND USE OF STAINLESS STEEL WIRE"	STANLEY P. WATKINS, Manager	Rustless Iron & Steel Corporation Baltimore, Maryland
WEDNESDAY, OCTOBER 25 MORNING SESSION, 9:30 A. M. NON-FERROUS DIVISION	R. G. BOWMAN, General Superintendent, International Smelting and Refining Co., East Chicago, Ind. Chairman of Meeting	Members of The Institute of Metals Division of the A.I.M.M.E. are invited to attend this session of the Non-Ferrous Division without payment of The Wire Association registration fee.
"ELECTRIC RESISTANCE WIRES"	DR. C. L. MANTELL, Technical Director	Wilbur B. Driver Company Newark, New Jersey
"WIRE SOLDER—ITS MANUFACTURE AND USES"	ROBERT A. GARDINER, President	Gardiner Metal Company Chicago, Illinois
WEDNESDAY, 1:00 P. M.	WIRE ASSOCIATION LUNCHEON	
Guest Speaker—MAJOR GEN. J. O. MAUBORGNE, Chief Signal Officer, U. S. Army (Members are at liberty to invite guests to hear this interesting speaker talk on a topic of national interest pertinent to the Wire Industry.—Members and guests of other societies participating in the National Metal Congress are also invited to attend.)		
WEDNESDAY, OCTOBER 25 Afternoon Session—3:00 P. M.	Annual Meeting of The Wire Association F. A. WESTPHAL, Superintendent, Wire Mills, Sheffield Steel Co., Kansas City, Mo. PRESIDENT OF THE ASSOCIATION CHAIRMAN OF MEETING	
THE MORDICA MEMORIAL LECTURE	"A CORRELATION OF THE FACTORS AND EFFECTS OF COLD DRAWING OF WIRE RODS"	DR. S. A. BRALEY, A.B., A.M., Ph.D., Chief Metallurgical Field Engineer, Pittsburgh Steel Co., Pittsburgh, Pa.
WEDNESDAY, OCTOBER 25 EVENING — 7:30 P. M.	ANNUAL DINNER — STAG SMOKER — THE CONGRESS HOTEL	
THURSDAY, OCTOBER 26 MORNING SESSION—9:45 A. M.	DR. W. W. HODGE, American Iron and Steel Institute, Research Fellow, Mellon Institute of Industrial Research, Pittsburgh, Pa. CHAIRMAN OF MEETING	JOINT MEETING BOTH DIVISIONS
Symposium: THE DISPOSAL OF WASTE ACID.		
THURSDAY, OCTOBER 26 AFTERNOON SESSION—1:30 P. M.	VISIT TO REPUBLIC STEEL CORP. WIRE MILL	BY BOTH DIVISIONS
THURSDAY EVENING, OCTOBER 26—7:00 P. M.	AMERICAN SOCIETY FOR METALS DINNER	AT PALMER HOUSE
(Tickets for this dinner may be obtained at The Wire Association Registration Desk in the Congress Hotel.)		

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BEARD, READE M., Practice Supervisor,
Wire & Nail Mill,
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Office Chief Signal Officer,
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BOLL, JOHN K., Manager Wire Sales Div.,
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(Please turn to Page 598)

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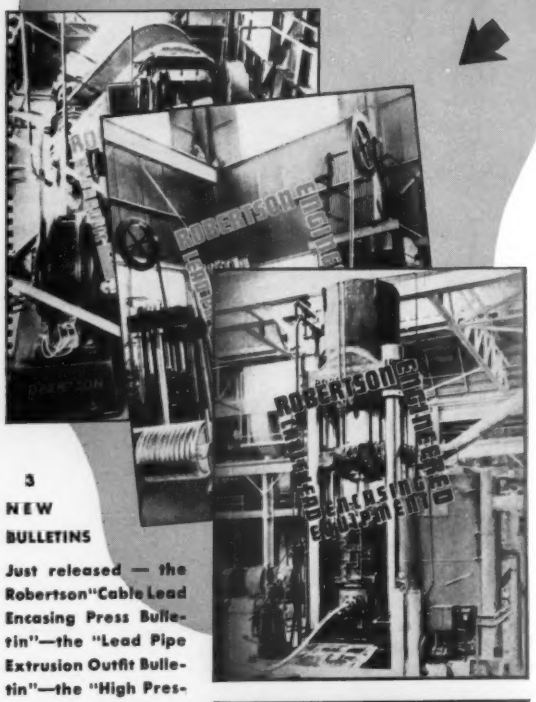

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WWP-10-39

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(Continued from Page 597)

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BROWN, RICHARD E., Publisher, WIRE & WIRE PRODUCTS, 300 Main Street, Stamford, Conn.

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BRYANT, F. H., Secretary, The Western Automatic Machine Screw Co., Elyria, Ohio.

BUCHANAN, D. D., Assistant General Manager, Union Drawn Steel, Div. of Republic Steel Corp., Harsh Ave., Massillon, Ohio.

BULLOCK, CAPTAIN FRANK W., Office of the Assistant Secretary of War, War Department, Washington, D. C.

BUSH, MAJOR GEO. P., Signal Corps., U. S. Army, 65 Beech Ave., Alta Vista, Bethesda, Md. Signal Section, Army Base, Brooklyn, N. Y.

BUTLER, J. F., Superintendent, Milton Manufacturing Co., Milton, Pa.

BUTLER, VICTOR H., Metallurgist, Baxters (Bolts, Screws & Rivets) Ltd., Parade Works, Sheepcote St., Birmingham, England.

CALLAGHAN, JOHN C., Works Manager, Canada Works, Steel Co. of Canada, Ltd., Wellington Str., Hamilton, Ontario, Canada.

CARNAHAN, H. B., Assistant Works Manager, Canada Wire & Cable Co., Ltd., & Standard Underground Cable Co. of Canada, Ltd., Box 340, Toronto, Ontario, Canada.

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DERN, EMIL, Secretary,
Kelly Wire Die Corp.,
19 W. 34th St., New York, N. Y.
DILLON, W. M., Assistant Secretary,
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DIMLING, PAUL E., (Firthaloy Salesman),
Firth-Sterling Steel Co.,
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DOMES, VIKTOR, Wire Engineer,
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299 Madison Ave., New York, N. Y.
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EARLY, E. F., Superintendent,
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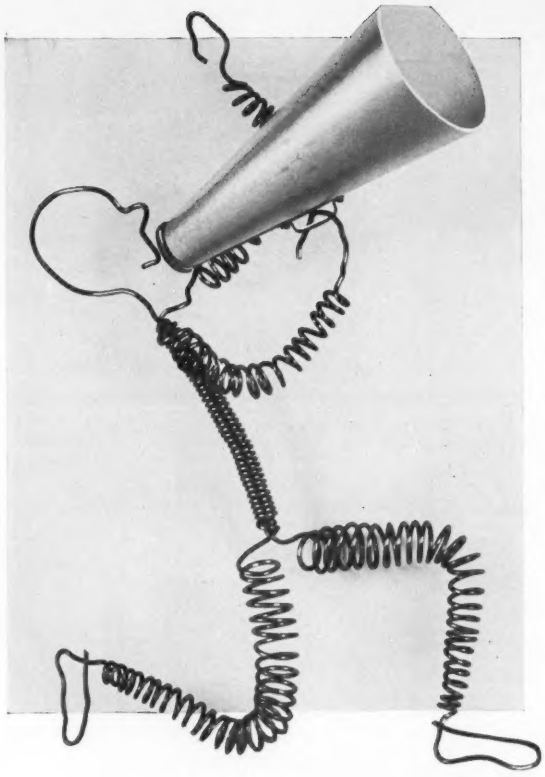
Morgan Works, Worcester, Mass.
EASTLAKE, WM. H., Asst. Gen. Supt.,
Northern Electric Co., Ltd.,
1261 Shearer St., Montreal, P. Q., Canada.
EATON, R. M., Resident Manager,
Hazard Insulated Wire Works,
70-74 Hazle St., Wilkes-Barre, Pa.
EDICK, H. L., Plant Supt.,
Wickwire Brothers,
189 E. Main St., Cortland, N. Y.
ELDER, FLINT C., Chief Metallurgist,
American Steel & Wire Co.,
Rockefeller Bldg., Cleveland, Ohio.
ELIAS, H. W., Assistant Manager,
Firthaloy Div, Firth-Sterling Steel Co.,
(Address—135-24 78th Road,
Kew Garden Hills, Flushing, L. I., N. Y.)
ENTWISTLE, JAMES L.,
88 Pleasant St., Pawtucket, R. I.
ERICKSEN, C. A., Westinghouse Lamp Div.,
Westinghouse Elec. & Mfg. Co.,
Bloomfield, N. J.
FANTONE, CHARLES B., President,
Syncro Machine Co.,
420 Lexington Ave., New York, N. Y.
(Home—414 Third Ave., Lyndhurst, N. J.)
FARNSWORTH, W. B., Chief Metallurgist,
Pittsburgh Steel Co., Monessen, Pa.
FAST, PAUL R., Plant Supt.,
Belden Manufacturing Co.,
4647 W. Van Buren St., Chicago, Ill.
FINDLEY, J. K., Metallurgist,
Allegheny-Ludlum Steel Co.,
Dunkirk, N. Y.
FIRTH, F., Managing Director,
Overend & Co., Ltd., Mount Tabor,
Works, Leeds 9, Yorks., England.
FIRTH, L. GERALD, Pres. & Gen. Mgr.,
Firth-Sterling Steel Co.,
McKeesport, Pa.
FISHER, EDWARD J. P., Asst. Mgr.,
Tube Mills & Cold Drawing Div.,
Aetna-Standard Engineering Co.,
Youngstown, Ohio.

(Please turn to Page 600)



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For many years Keystone has been producing wire for every sort of manufacturing purpose. We've helped many of our customers smooth out production difficulties by thoroughly studying their requirements and developing the right wire for their use. Possibly our technical staff could be of service to you, too.

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Wire Association Membership List — 1939

(Continued from Page 599)

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FOSS, DR. ING., F. F., Assistant to Chairman and General Metallurgist,
Wheeling Steel Corp., Wheeling, W. Va.

FOUKAL, A., Manager,
Miscellaneous Steel Products Div.,
Truscon Steel Co.,
6100 Truscon Ave., Cleveland, Ohio.

FRANKLIN, W. R., Advertising Manager,
J. L. Clark Manufacturing Co.,
Rockford, Ill.

FRASER, J. C., Gen. Mgr.
Laidlaw Bale Tie & Wire Co., Ltd.,
Hamilton, Ontario, Canada.

FRASOR, J. R., Chief Inspector,
Northwestern Steel & Wire Co.,
Sterling, Ill.

FRASER, JOHN G., Manager,
The Northern Bolt Screw & Wire Co., Ltd.,
Owen Sound, Ontario, Canada.

FRIEDMAN, J. H., Vice President,
National Machinery Co.,
Tiffin, Ohio.

GADD, HARRY A.,
Canadian General Electric Co., Ltd.,
212 King St., W., Toronto, Ontario, Canada.

GAINES, FREDERICK W., 3rd, Mech. Engr.,
Ajax Manufacturing Co.,
Chardon Road, Euclid, Ohio.

GALLOWAY, JAMES W., Plant Engineer,
B. Greening Wire Co., Ltd.,
Hamilton, Ontario, Canada.

GIRVEN, J. E., Wire & Cable Engineer,
Canadian General Electric Co., Ltd.,
Peterborough, Canada.

GLADER, FRANK J., President,
Wm. Glader Machine Works,
210 N. Racine Ave., Chicago, Ill.

GLEN, A. E., Salesman,
Carboloy Co., Inc.,
704 2nd Ave., Pittsburgh, Pa.

GOETZ, M. E., Gen. Supt.,
Northwestern Steel & Wire Co.,
Sterling, Ill.

GORDON, C. S., Wire Develop. Engineer,
Bell Telephone Laboratories, Inc.,
463 West Street, New York, N. Y.

GRANGER, L. D., Assistant to Vice President,
Wickwire Spencer Steel Co.,
500 Fifth Ave., New York, N. Y.

GRASSELL, P. W., Pres. and Treas.,
Wilson Steel & Wire Co.,
4840 S. Western Ave., Chicago, Ill.

GUNDSTROM, E. W., Asst. Plant Manager,
Rome Cable Corp., Rome, N. Y

GUSCOTT, LOWELL E, Superintendent,
United Screw and Bolt Corp.,
3590 West 58th St., Cleveland, Ohio.

HAARBAUER, H. W.,
1705 4th Ave., New Brighton, Pa.

HAGUE, JOSEPH A., District Sales Manager,
Pittsburgh Steel Co.,
Union Trust Bldg., Cleveland, Ohio.

HAKA, JOHN E., Works Manager,
Midland Wire Corp.,
70 Hunter St., Tiffin, Ohio.

HAMAKER, R. L., District Sales Manager,
Warner Company,
122 E. 42nd St., New York, N. Y.

HAMMITT, S. J., Manager,
Morrison Steel & Wire Co., Ltd.,
Granville Island, Vancouver, B. C., Canada.

HANSEN, ELMER K., Secretary and Treasurer,
Central States Industrial Engineers,
229 Garden St., DeKalb, Ill.

HARMON, CHAS. D., Sales Engineer,
The National Machinery Co.,
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HARRIS, FRANCIS A., President,
F. A. Harris, Inc.,
425 Liberty St., Springfield, Mass.

HARRISON, N. C., Vice President,
Atlantic Steel Co.,
Box 1714, Atlanta, Ga.

HART, FRANK E., Manager,
Anaconda Wire & Cable Co.,
Marion, Ind.

HARTLEY, GEORGE D., Consultant,
311 Main Street, Worcester, Mass.

HARTWELL, RALF L., Assistant to President,
Metal Textile Corp.,
4 Central Ave., West Orange, N. J.

HENDERSON, KEITH T., Metallurgist,
Broken Hill Proprietary Co., Ltd.,
Port Waratah, Newcastle, N.S.W., Australia.

HEYN, H. M., Sales Manager in charge
Heat Treating Div.,
Surface Combustion Corp.,
2375 Dorr St., Toledo, Ohio.

HILL, H. W., Asst. Gen. Supt.,
Northwestern Steel & Wire Co.,
Sterling, Ill.

HIRE, HARRY E., Supt. Wire & Insulation Div.,
General Electric Co.,
Fort Wayne, Ind.

HITCHCOCK, WM. E., President,
Atlantic Wire Co.,
Branford, Conn.

HOEHLE, G. H., Dr. Ing., Metallurgist,
Hoesch, A. G., Dortmund, Germany.

HOHL, HENRY D., V. P. Charge Production,
Triangle Conduit & Cable Co., Inc.,
Dray Harbor Rd. & Cooper Ave.,
Brooklyn, N. Y.

HOLMQUIST, C. W., Gen. Supt.,
Copperweld Steel Co.,
Glassport, Pa.

HOLMQUIST, JOHN A.,
103 Major St., Aliquippa, Pa.

HOLTON, A. E., President,
Essex Wire Corp.,
37 Manchester Ave., Detroit, Mich.

HOOKER, HORACE W., JR., Develp. & Research.,
Hooker Electrochemical Co.,
Niagara Falls, N. Y.

HOPKINS, H. L., Metallurgist,
National Screw & Mfg. Co.,
2440 E. 75th St., Cleveland, Ohio.

HOPKINS, JAMES H., Sales Engineer,
Salem Engineer Co.,
714 So. Broadway, Salem, Ohio.

HORN, GEORGE B., Gen. Supt.,
The Wheeler Insulated Wire Co.,
378 Washington Ave., Bridgeport, Conn.

HORSFALL, D., Works Manager,
Canada Wire & Cable Co., Ltd.,
P. O. Box 340, G.P.O., Toronto, Ontario, Canada.

HORSFALL, HERBERT, Pres. & Man. Dir.,
Canada Wire & Cable Co., Ltd.,
P. O. Box 340, G.P.O., Toronto, Ontario, Canada.

HORSFALL, LIEUT. COL. J. H. C., Director,
Latch & Batchelor, Ltd.,
Hay Mills, Birmingham, England.

HOSMER, PAUL B., Salesman,
White & Hodges,
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HOTCHKISS, V. G., Asst. Supt., Wire Dept.,
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HUGHES, CHARLES E., Sales Engineer,
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(1934 North Talbott St., Indianapolis, Ind.)

HUGHES, WILFRED A., General Foreman,
Gilbert & Bennett Mfg. Co.,
Georgetown, Conn.

HUME, W. G., Gen. Manager of Sales,
Pittsburgh Steel Co.,
Grant Building, Pittsburgh, Pa.

HUSSEY, R. M., Supt. Wire Dept.,
Jones & Laughlin Steel Corp.,
Aliquippa, Pa.

IGOE, PETER, Treasurer,
Igoe Brothers,
69 Metropolitan Ave., Brooklyn, N. Y.

INGHAM, T. S., Asst. Sales Mgr.,
American Chemical Paint Co.,
Ambler, Pa.
(Address—77 Park Place, Newark, Del.)

IRELAND, D. B., Secretary-Treasurer,
Wolverine Bolt Co.,
9685 Grinnel Ave., Detroit, Mich.

IVES, C. G., Plant Superintendent,
The Acme Wire Co.,
New Haven, Conn.

JACKMAN, ALAN,
Firthaloy Division, Firth-Sterling Steel Co.,
710 W. Lake St., Chicago, Ill.

JAGIELSKI, OTTO F., Consulting Engineer,
Thomson-Judd Wire Machinery Co.,
161 Pleasant St., Lynn, Mass.

JEFFRIES, JAMES, Assistant Manager,
Driscoll Wire Co.,
Drawer Q, Shelton, Conn.

JENKS, FRANK, Production Superintendent,
Rylands Brothers (Australia) Ltd.,
Box 245, Newcastle, N.S.W., Australia.

JOHNSON, C. G., Supt., Rod and Wire Mills,
Bethlehem Steel Co.,
Sparrows Point, Md.

JOHNSON, F., General Manager,
Wickwire Spencer Steel Co.,
Buffalo, N. Y.

JOSEPHSON, HARRY C., Vice Pres. and Secr.
Smith & Davis Mfg. Co.,
1180 Central Industrial Ave., St. Louis, Mo.

KAVANAUGH, J. F., Manager Wire Division,
The C. O. Jelliff Mfg. Corp.,
Southport, Conn.

KENT, M. A., Manufacturing Director,
General Cable Corp.,
420 Lexington Ave., New York, N. Y.

KENYON, HAROLD G., Division Superintendent,
General Electric Co.,
100 Woodlawn Ave., Pittsburgh, Pa.

KERST, ORUM R., Metallurgical Engineer,
E. F. Houghton & Co.,
240 W. Somerset St., Philadelphia, Pa.

KIISTER, FREDERICK H., General Manager,
Canadian Bridge Co., Ltd.,
Walkerville, Ontario, Canada.

KING, CARL, Superintendent,
Wickwire Spencer Steel Co.,
Palmer, Mass.

KINN, L. E., President,
Seneca Wire & Mfg. Co.,
Box 71, Fostoria, Ohio.

KITTREDGE, F. B.,
Jones & Laughlin Steel Corp.,
Boston, Mass.

KLEIN, H. C., Sales Engineer,
B. F. Goodrich, Co., Akron, Ohio.

KNIGHT, W. W., JR., Engineer,
Morgan Construction Co.,
2530 Koppers Bldg., Pittsburgh, Pa.

KNOLL, W. F., Superintendent,
Jas. Pender & Co., Ltd.,
P. O. Box 938, St. John, N. B., Canada.

KNOWLTON, NEIL H.,
Electric Furnace Co., Salem, Ohio.

KRAKAUER, A., Secretary,
Kay Manufacturing Co.,
22 Warren St., Brooklyn, N. Y.

KRISE, R. W., Vice Pres. & Gen. Mgr.,
Milton Manufacturing Co., Milton, Pa.

KUNZ, MAJOR R. N.,
Fort Armstrong, Honolulu, T. H.

LAIDLAW, W. A., Secretary-Treasurer,
Hamilton Wire Products, Ltd.,
11 Whitfield Ave., Hamilton, Ontario, Canada.

LAUDER, A., Works Manager,
Phillips Electrical Works Ltd.,
Brockville, Ontario, Canada.

LAWRENCE, J. B., Sales Representative,
The Ironsides Company, Columbus, Ohio.
(Address—5 Marlette Place, White Plains, N. Y.)

LAWTON, M. P., Asst. Supt. Wire Mill,
Atlantic Steel Co.,
Box 1714, Atlanta, Ga.

LEACH, ROBERT H., Manager,
Handy & Harman, Bridgeport, Conn.

LEPAGE, L. J. C., Director,
Sambre-Escaut, S. A.,
Fontaine-L'Eveque, Belgium.

LEWIS, KENNETH B.,
Consulting Wire Mill Engineer,
43 Midland St., Worcester, Mass.

LIPMAN, H. H., Designing and Consulting Engr.,
Lipman Engineering Co.,
415 Van Braam St., Pittsburgh, Pa.

LONGNECKER, HARRY F., Sales Representative,
Firth-Sterling Steel Co.,
McKeesport, Pa.,
(Home—523 Holmes St., Wilkinsburg, Pa.)

LONGWELL, JAMES R., Chief Engineer,
Carboloy Co., Inc.,
2985 E. Jefferson Ave., Detroit, Mich.

LUND, C. T., Pres. & Gen. Mgr.,
New England High Carbon Wire Co.,
Millbury, Mass.

McCARTHY, B. L., Chief Metallurgist,
Wickwire Spencer Steel Co.,
River Road, Buffalo, N. Y.

McCOY, FREDERICK A., Engineer of Tests,
Sheffield Steel Corp., Kansas City, Mo.

McDONALD, D. C., Supt. Wire & Nail Mill,
Dominion Steel & Coal Corp., Ltd.,
Sydney, N. S., Canada.

McGOWAN, C. L., Supt. Rod & Wire Mill,
Atlantic Steel Co.,
P. O. Box 1714, Atlanta, Ga.

McGREEVY, J. G., Vice President,
Apco Mossberg Co.,
Attleboro, Mass.

McLAUGHLIN, T. F., Vice President,
Rustless Iron & Steel Corp.,
1001 Edison Highway, Baltimore, Md.

McSHEEHY, T. H., Sales Representative,
Wickwire Spencer Steel Co.,
221 N. LaSalle St., Chicago, Ill.

MacDOUGALL, J. KENNETH, Manager,
Rylands Brothers (Australia) Ltd.,
Box 245, Newcastle, N.S.W., Australia.

MACKAY, W. ROY, Asst. Supt. Rod & Wire Mill,
Bethlehem Steel Co.,
Sparrows Point, Md.

MACKIE, I. C., Engineer of Tests,
Dominion Steel & Coal Corp., Ltd.,
Sydney, N.S., Canada.

MACKLIN, P. M., Executive Vice President,
Wickwire Spencer Steel Co.,
500 Fifth Ave., New York, N. Y.

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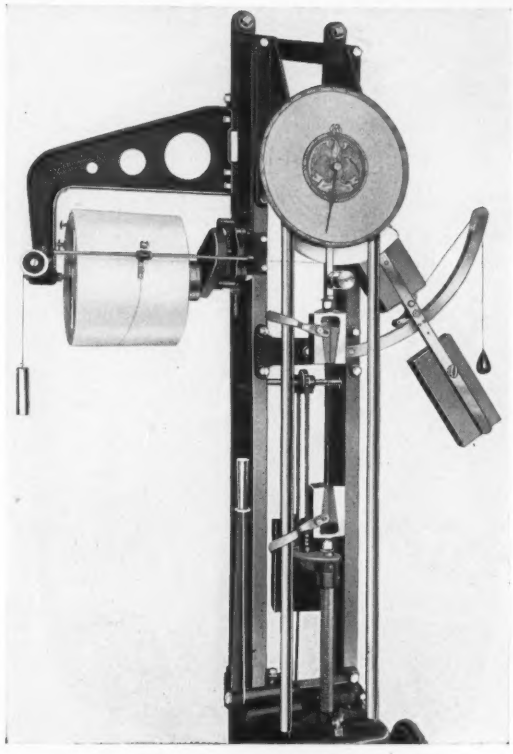
SCOTT *Improved* WIRE TESTING MACHINES



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Rigid construction eliminates machine deflection; operates with ¼ H. P. Motor to offer ranges of 0-250 and 0-500 lbs.; or 0-500 and 0-1000 lbs.

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Wire Association Membership List — 1939

(Continued from Page 601)

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Schenectady, N. Y.
MADISON, A. G., Secretary,
Madison Wire Co., Inc.,
550 Abbott Road, Buffalo, N. Y.
MAHONEY, EDMOND, Wire Mill Supt.,
Canadian Tube & Steel Products,
5765 Hamilton St., Montreal, P.Q., Canada.
MANNING, WM. H., Mgr., Insulation Dept.,
John A. Manning Paper Co., Inc.,
Troy, N. Y.
MARBURG, L. C., Secy. & Treas.,
Marburg Brothers, Inc.,
90 West St., New York, N. Y.
MARCUS, SAMUEL S., President,
Spring Products Corp.,
47-39 Austell Place, Long Island City, N. Y.
MARTIN, F. L., District Sales Manager,
Warner Company,
Oliver Building, Pittsburgh, Pa.
MAZE, HAMILTON, President,
W. H. Maze Co., Peru, Ill.
MELCHER, A. G., General Superintendent,
Hoskins Manufacturing Co.,
4445 Lawton Ave., Detroit, Mich.
MELLOWES, A. W., Vice Pres. & Gen. Mgr.,
National Lock Washer Co.,
241 East Erie St., Milwaukee, Wis.
MELVILLE, N. F., Manager, Manufacturing
Wire & Stainless Steel Wire Sales,
Pittsburgh, Steel Co.,
Grant Bldg., Pittsburgh, Pa.
MILLER, RANDOLPH, H., President,
R. H. Miller Co., Inc., Homer, N. Y.
MOODY, WILFRED, Managing Director,
The Lancashire Wire Co., Ltd.,
Trafford Park, Manchester 17, England.
MOOMAW, GEO. D.,
Rustless Iron & Steel Company,
Baltimore, Md.
MORGAN, PHILIP M., Treasurer,
Morgan Construction Co.,
15 Belmont St., Worcester, Mass.
MORGAN, WELD, Engineer,
Morgan Construction Co.,
15 Belmont St., Worcester, Mass.
MORITZ, JOHN A., Supt. Wire Mills,
Keystone Steel & Wire Co.,
Peoria, Ill.,
(Also Vice President, Charge Operations,
Mid-States Steel & Wire Co.,
Crawfordsville, Ind.)
MORRISON, J. R., President,
Morrison Engineering Corp.,
5005 Euclid Ave., Cleveland, Ohio.
MORROW, J. G., Metallurgical Engineer,
Steel Co. of Canada, Ltd.,
Hamilton, Ontario, Canada.
MOSLO, ERNEST P., Owner,
Moslo Machinery Inc.,
5005 Euclid Ave., Cleveland, Ohio.
MUCKLEY, D. S., Supt. Wire Mill,
Colorado, Fuel & Iron Corp.,
Pueblo, Colo.
MURPHY, P. M., Supt. Wire Dept.,
Northwestern Steel & Wire Co.,
Sterling, Ill.
MYERS, LEON C., Superintendent,
United Steel & Wire Co.,
P. O. Box 256, Battle Creek, Mich.
MYERS, H. A., Executive,
Terkelsen Machine Co.,
326 A Street, Boston, Mass.
NEHRING, PAUL A., President,
Nehring Electrical Works,
DeKalb, Ill.
NELSON, G. W., Superintendent,
Wickwire Spencer Steel Co.,
Clinton, Mass.
NEUHAUS, RICHARD, President,
Nukem Products Corp.,
76 Niagara St., Buffalo, N. Y.
NEWALL, A. P., Managing Director,
A. P. Newall & Co., Ltd.,
Balmore Road, Glasgow, N., Scotland.
NORTON, L. H., Director of Purchases,
The National Screw & Mfg. Co.,
2440 E. 75th St., Cleveland, Ohio.
NOWELL, H.,
P. O. Box 49, Station B., Montreal, P.Q., Canada.
(Representative, Sir James Farmer Norton &
Co., Ltd., Salford, Manchester, England.)
OBERHAUSER, THOMAS W., Sales Manager,
Wire & Tubular Products,
Laclede Steel Co.,
Arcade Building, St. Louis, Mo.
OLSON, ROBERT V., President,
Mossberg Pressed Steel Corp.,
Attleboro, Mass.
PAPENDICK, L. W., Asst. Chief Metallurgist,
Northwestern Steel and Wire Co.,
Sterling, Ill.
PARKIN, WILLIAM M., President,
Wm. M. Parkin Co.,
1005 Highland Bldg., Pittsburgh, Pa.
PATTERSON, JOHN W., Metallurgist,
Youngstown Sheet & Tube Co.,
Youngstown, Ohio.
PAULEY, RALPH H., Vice President,
Pittsburgh Tool Steel Wire Co.,
Monaca, Pa.
PEARSON, O. G., Wire Mill Superintendent,
Continental Steel Corp., Kokomo, Ind.
PETERSON, A. H., President,
Precision Spring Products Corp.,
15400 Woodrow Wilson Ave., Detroit, Mich.
PETERSON, R. O., Development Engineer,
Osborn Manufacturing Co.,
5401 Hamilton Ave., Cleveland, Ohio.
PIERSON, W. D., Secretary,
Waterbury, Farrel Foundry & Machine Co.,
Waterbury, Conn.
POTTER, EARL R., Superintendent,
The California Wire Cloth Corp.,
Standard Wire Division,
South San Francisco, Calif.
PRICE, W. B., Chief Chemist & Metallurgist,
Scovill Manufacturing Co., Waterbury, Conn.
PURTELL, WILLIAM A., President,
The Holo Krome Screw Corp.,
P. O. Box 360, Hartford, Conn.
QUINN, J. J., Managing Director,
Metal Products Ltd.,
Marina Industrial Estate, Cork, Ireland.
RAITHEL, ARTHUR C., Factory Manager,
Vascoloy Ramet Corp.,
North Chicago, Ill.
RANDALL, H. L., President,
Riverside Metal Co., Riverside, N. J.
REA, V. F., President,
Rea Magnet Wire Co.,
Fort Wayne, Ind.
REEDER, A. M., Metallurgical Engineer,
Jones & Laughlin Steel Corp.,
3rd & Ross Sts., Pittsburgh, Pa.
RENFER, E. A., Manager,
Sycamore Mill, Anaconda Wire & Cable Co.,
Sycamore, Ill.

Commercial Diamond Prices Go Up

ACCORDING to the New York Times war developments have brought a sharp increase in diamond prices and a shortage of the smaller stones is threatened. A rise of 35 per cent has been reported for diamonds ranging in size to one-quarter carat, with a 20 per cent advance made on larger gems.

✦ ✦ ✦

INDUSTRIAL diamonds have had a much larger percentage increase, quotations on them having trebled in some instances. More than half of the diamonds imported into this country are used for industrial purposes, in the manufacture of machinery, etc.

✦ ✦ ✦

CRIPPLING of cutting operations through mobilization in Holland and Belgium, the British embargo against diamond exports and an increased speculative and investment demand have brought about the rise. The United States is the largest single purchaser of diamonds and the gem trade here is watching developments very closely. Despite the rise, however, it was indicated in some quarters that there is a substantial supply of rough stones available in this country, imports having risen sharply in the weeks immediately preceding the outbreak of the war.

✦ ✦ ✦

IN an interview with the Times reporting an upswing in the demand for industrial diamonds, following the hand-to-mouth buying of the last eight years, Dorus Van Itallie, president of J. K. Smit & Sons, Inc., local representatives of the well-known Dutch diamond firm of J. K. Smit and Zonan, Amsterdam, said that indications pointed to further heavy accumulations of diamonds for industrial purposes.

✦ ✦ ✦

POINTING out that Great Britain was not permitting diamond exports, Mr. Van Itallie said Belgium has also prohibited such exports. Shipments have been received from Holland, but prices are up sharply. Where shipments have been made on other than Dutch ships, high war risk insurance costs have been a factor.

BELGIUM and Holland have been the chief diamond-cutting centers of the world. Reports here indicated that mobilization in those countries has affected 40 per cent of the available diamond cutters.

✦ ✦ ✦

GREAT BRITAIN, home of the Diamond Syndicate which controls the world's supplies through the stones it turns over to the Diamond Trading Company, has banned exports in the fear that the stones would fall into German hands for war machinery production. Estimates were made in one quarter that the Diamond Syndicate in London has approximately £2,000,000 worth of rough diamonds on hand. These normally are sold to the cutters, who in turn sell the stones to importers for distribution to retailers.

✦ ✦ ✦

THE rise in small stones, or "mellie" as they are called in the trade, has been most pronounced, due in part to the fact that Germany did much of the cutting of these stones and these supplies have now been cut off.

Wire Association Membership List — 1939

(Continued from Page 602)

RENNELL, H. H., Secretary & Treasurer,
The C. O. Jelliff Manufacturing Corp.,
Southport, Conn.

RICHARDS, WALTER A., President,
Micro Products Co.,
20 North Wacker Drive, Chicago, Ill.

RICHARDS, G. WHITFIELD,
1732-36 Carlton Ave., and 1733-35 Wood St.,
Philadelphia, Pa.

RIGBY, HAROLD W., Director,
Thomas Wood & Son (Heckmondwike) Ltd.,
Union Road, Heckmondwike, Yorks., England.

RIGBY, JOHN, Director,
John Rigby & Sons, Ltd.,
Manchester, England.

RIVIERE, JORGE A., Manager Wire Works,
Riviere y Cia,
Ronda San Pedro, 58, Barcelona, Spain.

ROEBLINGS, JOHN A., SONS CO.,
Trenton, N. J.,
Company Membership. (10)

ROLLE CARL, Mechanical Engineer,
International Nickel Co., Inc.,
67 Wall St., New York, N. Y.

ROLLE, SIDNEY, Assistant Manager,
U. S. Metals Refining Co.,
420 Lexington Ave., New York, N. Y.

ROTH, EUGENE, Manager,
Carboloy Company, Inc.,
Graphic Arts Bldg., Worcester, Mass.

ROTH, RALPH B., Purchasing Agent,
Ludlow Saylor Wire Co.,
636 South Newstead Ave., St. Louis, Mo.

ROWLAND, W. A., Works Manager,
The Steel Company of Canada, Ltd.,
Postal Station "C", Toronto, Ont., Canada.

ROYLE, CHARLES J., Vice President,
Hudson Wire Co.,
62 Water St., Ossining, N. Y.

RUTHERFORD, F. H., Superintendent,
B. Greening Wire Co., Ltd.,
Hamilton, Ontario, Canada.

RYAN, L. A., Assistant to President,
Fisko Brothers Refining Co.,
129 Lockwood St., Newark, N. J.

RYERLY, H. COURTLAND, Treasurer,
Gehret Company, Inc., Bridgeport, Pa.

RYLANDS, G. K., General Manager,
Rylands Brothers, Ltd.,
Warrington, England.

SANDELIN, ROBERT W., Metallurgist,
Atlantic Steel Co., Atlanta, Ga.

SCHUELER, JULIAN L., General Superintendent,
Continental Steel Corp.,
Kokomo, Ind.

SCHULTZ, W. J., Chief Engineer,
Firth-Sterling Steel Co.,
McKeesport, Pa.

SCHWARTZ, WILLIAM, Secy. & Asst. Treas.,
Anton Smit & Co., Inc.,
24 State St., New York, N. Y.

SEBURN, WM. A., Superintendent Wire Mills,
Pittsburgh Steel Co., Monessen, Pa.

SEE, THEO. S., Vice President,
LaSalle Steel Co., Hammond, Ind.

SEE, WALTER GEORGE, Sales & Service Mgr.,
Submerged Combustion Co. of America, Inc.,
Hammond, Ind.

SEIFERT, CHARLES G., Secy. & Supt.,
La Consolidada, S. A.,
Apartado 81 Bix., Mexico City, D. F.

SELBY, C. H., Managing Director,
British Ropes, Canadian Factory, Ltd.,
Granville Island, Vancouver, B.C., Canada.

SENDZIMIR, T., Director,
Metallurgical Products Co., Ltd.,
Guernsey, C. I., 6 Avenue Gourgaud,
Paris, 17e, France.

SEYMOUR, LeROY D., Asst. Supt. West Mill,
The Steel Company of Canada, Ltd.,
Canada Works, Hamilton, Ontario, Canada.

SHEARER, MAJOR A. M.,
Signal Corps., War Department,
Aircraft Radio Laboratory, Wright Field,
Dayton, Ohio.

SHERMAN, WALDO L., Secretary-Treasurer,
John Robertson Co., Inc.,
133 Water St., Brooklyn, N. Y.

SHILLING, J. H., Supt. Wire Division,
Youngstown Sheet and Tube Co.,
Youngstown, Ohio.

SHOWELL, PHILLIP S., Plant Supt.,
Swan-Finch Oil Corp.,
120 Lister Ave., Newark, N. J.

SIMMONS, R. S., General Metallurgist,
Keystone Steel & Wire Co.,
Peoria, Ill.

SIMPSON, C. M., JR., Capt. Signal Corps.,
U. S. Army, Army Base,
Brooklyn, N. Y.

SINGH, BLADEV SARDAH, Managing Director,
Indian Steel & Wire Products, Ltd.,
E.I.R. Works, P.O., Tatanagar, B.N.R., India.

SKADE, EDWARD M.,
1311 S. 48th St., Cicero, Ill.,
(Foreman High Carbon Wire Drawing Mill,
Nachman Spring-Filled Corp.,
2039 N. Kolmar Ave., Chicago, Ill.)

SLEPAIN, ARTHUR, General Manager
The Wheeler Insulated Wire Co.,
378 Washington Ave., Bridgeport, Conn.

SLIFKA, M., Purchasing Agent,
Parker-Kalon Corp.,
300 Varick St., New York, N. Y.

SMITH, J. GODFREY, Vice President,
Federal Wire & Cable Co., Ltd.,
Guelph, Ontario, Canada.

SMITH, VAN DORN C., Sales Dept.,
Oakite Products, Inc.,
22 Thames St., New York, N. Y.

SOMERS, J. L., Vice President,
Texas Nail & Wire Mfg. Co.,
Box 516, Galveston, Texas.

SOMERVILLE, W. E., President,
W. E. Somerville Co.,
Coal City, Ill.

SOMMER, D. P., Vice Pres. & Gen. Supt.,
Keystone Steel & Wire Co.,
Peoria, Ill.

SOMMER, LESTER B., Assistant to President,
Mid-States Steel & Wire Co.,
Crawfordsville, Ind.

SPEAR, EMERSON, Vice President,
Pacific Wire Rope Co.,
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American Chemical Paint Co.,
Ambler, Pa.

STAPLES, HORACE A., Vice President
In Charge of Manufacturing,
Phelps Dodge Copper Products Corp.,
40 Wall St., New York, N. Y.

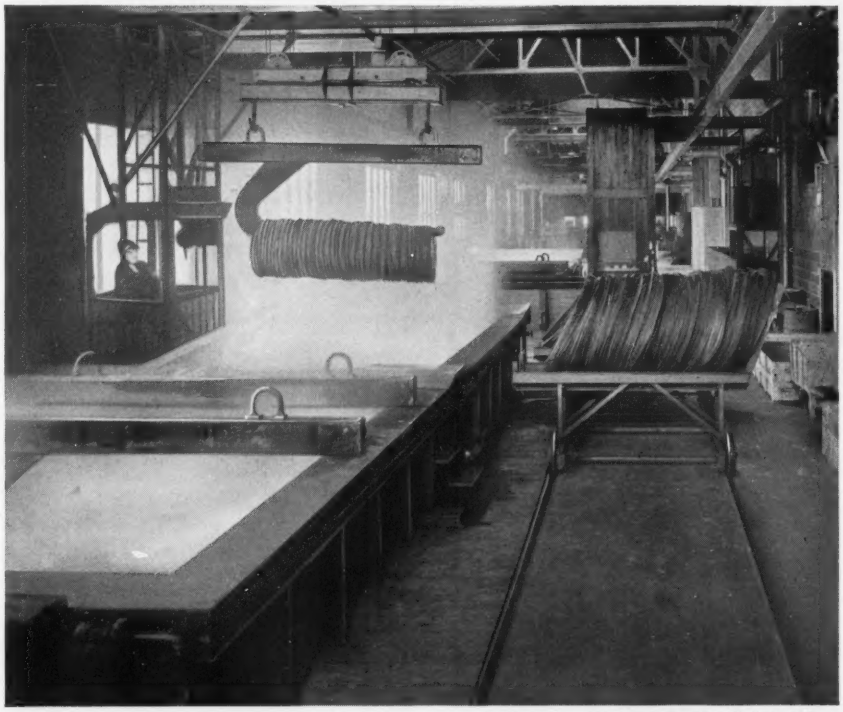
STEELE, R. J., Chief Engineer, Firthaloy Div.,
Firth-Sterling Steel Co.,
McKeesport, Pa.

STEVICK, R. S., Works Manager,
Firth-Sterling Steel Co.,
McKeesport, Pa.

STIER, GEO. G., Asst. Sales Mgr., Specialties Div.,
National Oil Products Co.,
1st & Essex Sts., Harrison, N. J.

(Please turn to Page 604)

BASOLIT *Protected* PICKLING TANKS



Courtesy of B. F. Goodrich Co.

Installed in Dec. 1935, the two wire pickling tanks shown above are rubber lined steel with sheathing of double brick and BASOLIT. Each tank is 14½ ft. long x 10 ft. wide x 6½ ft. deep.

This installation is one of the many hundred where BASOLIT has contributed toward long life and efficient operation of modern pickling equipment.

NUKEM PRODUCTS CORP.

BUFFALO, N. Y.

New York Pittsburgh Detroit Kitchener, Ont.

Wire Association Membership List — 1939

(Continued from Page 603)

STIRLING, A. B., Secretary,
N., Greening & Sons, Ltd.,
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STRICKLEN, JOHN R., Vice President,
National Rubber Machinery Co.,
Akron, Ohio.

STUMPF, GORDON A., Metallurgist,
Research Dept., Timken Roller Bearing Co.,
Canton, Ohio.

SULLIVAN, F. W., Treasurer,
Greif Brothers Cooperage Co.,
2000 W. 25th St., Cleveland, Ohio.

SUZUKI, MEISAKU,
No. 910-5 Chome Higashitetsu-machi,
Yawata-Shi, Fukuoka-Ken, Japan.

SYMONDS, GEO. HENRY, Managing Director,
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Enfield, Middlesex, England.

TANG, S. Y.,
Hong Kong Nail Factory,
Tong Shui Road, King's Road,
Hong Kong, China.

TATNALL, RODMAN R., Engineer,
Wickwire Spencer Steel Co.,
Worcester, Mass.

THOLAND, NILS K. G.,
Ekstrand & Tholand, Inc.,
441 Lexington Ave., New York, N. Y.

THOMAS, EARLE H., Superintendent,
Geo. W. Prentiss & Co.,
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TIMBERLAKE, J. E., Wire Dept.,
Jones & Laughlin Steel Corp.,
Pittsburgh, Pa.

TWIBLE, W. J., Works Manager,
Graham Nail & Wire Products, Ltd.,
7 Fraser Ave., Toronto, Ontario, Canada.

ULLMANN, LEO, Managing Director,
Chiswell Wire Co., Ltd.,
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VAN HOOK, CHARLES F., Manager,
Cable & Wire Machinery Division,
and Chief Engineer, Watson Machine Co.,
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VAUGHAN, CURTIS H., Sales Engineer,
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WARD, C. T., Assistant Superintendent,
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WARNER, CHARLES M., Supt. of Wire Mill,
Scovill Manufacturing Co.,
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Rustless Iron & Steel Corp.,
3400 E. Chase St., Baltimore, Md.

WEBB, E. H., President,
Webb Wire Works,
17 Liberty St., New Brunswick, N. J.

WEIKEL, G. A.,
130 Main St., Evanston, Ill.
(Sales Engineer, American Chemical Paint Co.,
Chicago, Ill.)

WEINMANN, E. R., Sales Manager,
Nukem Products Corp.,
55 West 42nd St., New York, N. Y.

WELSH, J. ALAN, Sales Engineer,
Firth-Sterling Steel Co., Firthaloy Div.,
410 New Park Ave., Hartford, Conn.

WERME, M. G., Plant Superintendent,
Wickwire Spencer Steel Co.,
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WESSEL, E., Vice President,
Beall Tool Co., East Alton, Ill.

WESTPHAL, FREDERICK A., Supt. Wire Mills,
Sheffield Steel Corp.,
Kansas City, Mo.

WHITNEY, LESLIE C., Chief Metallurgist,
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Glassport, Pa.

WHYTE, R. B., General Superintendent,
Macwhyte Co., Kenosha, Wis.

WICKWIRE, CHESTER F., Vice President,
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WIGGINS, C. R., Chief Metallurgist,
Northwestern Steel & Wire Co.,
Sterling, Ill.

WILCOX, RICHARD L., Vice President,
Waterbury Farrel Foundry & Machine Co.,
Waterbury, Conn.

WILEY, WILLIAM G., Asst. to Gen. Sales Mgr.,
General Cable Corp.,
420 Lexington Ave., New York, N. Y.

WILLIAMS, ROBERT C., Chief Chemist,
The Ironsides Company,
270 W. Mound St., Columbus, Ohio.

WILSON, FRANK B., Gen. Wks. Mgr.,
Guest, Keen & Nettlefolds, Ltd., Atlas Works,
Darlaston, S. Staffs., England.

WIND, WILLIAM J., Secretary,
Wilbur B. Driver Co.,
150 Riverside Ave., Newark, N. J.

WINKLER, L. H., Metallurgical Engineer,
Bethlehem Steel Co.,
Bethlehem, Pa.

WINTERSOHL, A. H., Superintendent,
Firthaloy Division, Firth-Sterling Steel Co.,
McKeesport, Pa.

WITHINGTON, ROBERT W., President,
American Insulating Machinery Co.,
517 W. Huntingdon St., Philadelphia, Pa.

WOOD, MAURICE L.,
Chase Brass & Copper, Inc.,
Waterbury, Conn.

WOODFORD, F. M., Western Manager,
Tungsten Electric Corp.,
2900 Euclid Ave., Cleveland, Ohio.

WOODHEAD, R. R., Research Engineer,
John A. Manning Paper Co., Inc.,
Troy, N. Y.

YEAGER, L. R.,
Owens-Corning Fiberglas Corp.,
Toledo, Ohio.

YORT, A. O., Supt. Wire & Tack Mill,
Republic Steel Corp., Grand Crossing Works,
South Chicago, Ill.

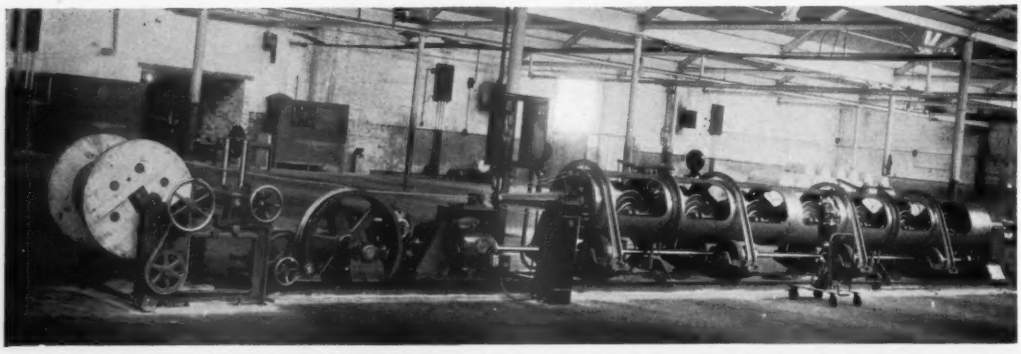
YOUNG, LAFE, General Superintendent,
Laclede Steel Co., Alton, Ill.

ZAPP, A. R., Manager Firthaloy Div.,
Firth-Sterling Steel Co.,
McKeesport, Pa.

ZARAFUS, HERMAN, Plant Engineer,
Circle Wire & Cable Co.,
550 Maspeth Ave., Maspeth, L. I., N. Y.

ZOUCK, JOHN, Chief Inspector,
Bethlehem Steel Co.,
Sparrows Point, Md.

Announcing the New 1940 Model National Tube Type Strander



THIS Strander is equipped with variable speed haul-off eliminating the use of change gears. With the new National Strander, changing lay lengths is but a matter of seconds.

✦ ✦ ✦

CHANGING from right lay to left lay requires only the shifting of clutch lever; electric brakes of latest type add much to the efficiency of operation.

✦ ✦ ✦

THIS Strander is equipped with ball-bearings throughout, has Textilite tube rollers and Carboloy wire guides, quick operating bobbin latches and bobbin brakes.

✦ ✦ ✦

Made for 9″, 12″, 16″ and 22″ standard bobbins.
Equipment for Wire and Rubber Industries.

NATIONAL RUBBER MACHINERY CO.

General Offices: AKRON, OHIO

Banner Division, COLUMBIANA, OHIO
Eastern Division, CLIFTON, N. J.

David Bridge & Company, Ltd., Manchester, England
The Bawden Machine Company, Ltd., Toronto, Canada

Bus Service to National Metal Exposition October 23-27, 1939

ARRANGEMENTS have been completed with the Gray Line Company to provide special 36-passenger bus service operating on a regular schedule from the Palmer House, Congress, Blackstone and Stevens Hotels downtown to the International Amphitheatre at 43rd and Halsted Street and return.

✦ ✦ ✦

THE bus service will start at 11:00 o'clock each day and continue until 11:00 o'clock at night and leave from downtown and the Amphitheatre on a regular 15-minute schedule.

✦ ✦ ✦

THIS 15-minute schedule is to be maintained from 11:00 a. m. to 2:00 o'clock, and from 2:00 until 6:00 buses will operate on a 30-minute schedule. However, beginning at 6:00 o'clock and continuing until 11:00 p. m. the 15-minute schedule will be maintained.

A 15-minute service will also be maintained from the Palmer House, Congress, Blackstone and Stevens Hotels, headquarters of the cooperating societies. In other words, the bus leaving the Palmer House at 11:00 a. m. is scheduled to arrive and pick up passengers at the Congress at 11:05 and the Blackstone and Stevens at 11:10. The bus leaving the Palmer House at 11:15 will do the same, and all buses will make the swing to pick up passengers every trip.

✦ ✦ ✦

THE charge will be 25c each way. Strips of 5 tickets will be sold for $1.00. Tickets will be on sale at the registration desks of all co-operating societies and from Gray Line representatives located at the Palmer House and Stevens Hotel.

✦ ✦ ✦

A. S. & W. Co. Prices

THE American Steel & Wire Company announced on Septemper 18, reaffirmation of present base prices on hot rolled rods, manufacturers' wires, cold rolled strip and commodity strip, for shipment up to and including December 31, 1939, for delivery and consumption in the United States.

✦ ✦ ✦

PRICES are to apply only on such shipments made up to and including December 31, 1939, and any shipments after that date will be invoiced at prices in effect at time of shipment.

✦ ✦ ✦

Tack and Rivet Orders Up

WAR in Europe has brought a boom to manufacturers of copper tacks, rivets, eyelets and similar merchandise. Producers reported that orders from abroad in the last two weeks were ten times greater than normal. The heaviest buying has been from Latin - American importers who have depended upon German suppliers in the past, but volume orders have come also from England, France, China, Japan, Soviet Russia and South Africa.

You can roll up "reel" savings with

"American" Pressed-Steel Spools and Reels

We have all the tools, dies and modern equipment necessary to produce every type of spool and reel skillfully, quickly and economically. "American" Pressed-Steel Spools are used widely in the wire industry for production operations and shipping. They are light, clean and sturdy.

"American" Pressed-Steel Reels meet all the requirements of braiding, drawing, annealing, vulcanizing and shipping. The services of our Engineering Department are available, without obligation. Let us quote on your requirements.

Special Representative

WALTER A. RICHARDS
20 No. Wacker Drive
Chicago, Ill.

THE AMERICAN PULLEY CO.
4200 WISSAHICKON AVE.
Philadelphia, Pa.

Standard Methods for the Sampling and Analyzing of Aluminum and Certain Aluminum Alloys

THE Second Edition of Aluminum Research Institute's "Standard Methods for the Sampling and Analyzing of Aluminum and Certain Aluminum Alloys" is being released today by that trade association of manufacturers of secondary aluminum from its headquarters at 308 West Washington Street, Chicago.

✦ ✦ ✦

FROM crude beginnings some 30 years ago, the technique of the aluminum smelting industry has advanced rapidly, until today Aluminum Ingot is produced by smelting specialists who are strict in their laboratory control. This scientific development has made possible the wider uses and the greater applications of Secondary Aluminum for purposes demanding quality and the adherence to exacting chemical and physical specifications.

✦ ✦ ✦

Four Big Reasons why it pays to use

FERRISUL

FOR PICKLING STAINLESS STEEL WIRE

Does your present pickling agent continue to etch the metal after scale is removed? Do toxic fumes from your pickling bath endanger your workmen? If you face either of these problems, pickling with Ferrisul-Hydrofluoric solutions will bring a quick end to your troubles.

Ferrisul saves metal loss. There is a substantial decrease in metal loss when Ferrisul is used, giving you savings both in metal and acids.

Ferrisul is safe to handle. Practically no fumes arise from Ferrisul-Hydrofluoric pickling baths. Since Ferrisul (Anhydrous ferric sulfate) comes in dry, granular form, it is safe and convenient to store and handle.

Ferrisul gives you a better product. The use of Ferrisul in pickling stainless steel wire delivers a smoother product free from pits and scratches... and with Ferrisul, higher speeds of drawing are possible.

Ferrisul reduces chemical costs. The cost of Ferrisul solutions usually is less than those using Muriatic or Nitric-Hydrofluoric acids. Pickling baths last longer and shut-downs for cleaning and renewing pickling baths are less frequent.

FERRISUL

FOR PICKLING STAINLESS STEEL

WRITE FOR FACTS—Complete information on the use of Ferrisul solutions in pickling stainless steel will be sent promptly upon request. MONSANTO CHEMICAL COMPANY, Merrimac Division, Everett Station, Boston, Massachusetts.

MONSANTO CHEMICALS

SERVING INDUSTRY... WHICH SERVES MANKIND

WITH the rapid development of the industry, a diversity of methods and techniques in analyzing Aluminum and its Alloys grew up. At times, this lack of uniform practice caused serious hardship to those smelters who sincerely desire to furnish, and to consumers who rightfully insist upon receiving, quality alloys which will comply with required chemical and physical specifications. To meet this situation, the Aluminum Research Institute, some nine years ago, created its Chemists' Committee, composed of the chief chemists of each of its member companies. As a result of extensive surveys of the data and technique then available, by check analyses of carefully prepared standard samples, through reams of correspondence, and many meetings, the Chemists' Committee made available for publication by Aluminum Research Institute, in 1932, the First Edition of its "Standard Methods for the Sampling and Analyzing of Aluminum and Certain Aluminum Alloys."

✦ ✦ ✦

THE methods of analyzing aluminum and its alloys that were commonly available some ten years ago, were satisfactory for analyzing the simple alloys that had been used in the early days of aluminum. However, when chemists were called upon to analyze the rapidly increasing number of complex aluminum alloys, including secondary aluminum, containing wide assortments of elements, among which were many of the rare elements, the then available methods were found to be inadequate. The First Edition of the "Methods" was developed to meet these needs. Of the thirteen methods which the First Edition contained, five remain unchanged in the Second Edition, and four additional methods have been added.

✦ ✦ ✦

REMARKABLE strides have been made since 1932 in the analytical technique used by consumers as well as by certain manufacturing specialists of Aluminum Ingot in the necessary degree of accuracy, simplified procedure, minimum testing time, and moderate cost. In the preface of the First Edition of the "Methods",

the Institute stated its intention to issue, from time to time, methods of sampling and analyzing based on the foregoing requirements.

✦ ✦ ✦

SINCE 1932, the work of the Institute's Chemists' Committee has been aggressively continued. Since the existence of the Chemists' Committee, some 40 standard samples of alloys of various types have been prepared with the most exacting accuracy, have been issued to the members, analyzed, and the results compared. From time to time, the Chemists' Committee has met in two-day sessions. Weaknesses of methods, whether of precision, complexity, or time required, have been discussed. Improvements developed by one chemist, or in one laboratory, have been freely passed on for trial to the others. The Second Edition of these "Methods" is the result.

✦ ✦ ✦

OWING to the substantial cost of this undertaking, the Second Edition of the "Methods" is limited in number. A complimentary copy of it is available to domestic consumers of aluminum alloys who maintain their own laboratory, to Commercial Laboratories, and Technical Schools and Colleges. A charge of one dollar per copy will be made to others. If a consumer of aluminum does not operate his own laboratory, the Institute will, upon request of such consumer, send a complimentary copy to the commercial chemist who does such consumer's laboratory work.

✦ ✦ ✦

Correction

IN the September issue of Wire and Wire Products (Page 464), the 1938 report of the Non-Ferrous Metals Committee, Industrial Gas Section, American Gas Association, was published—and this report made reference to the new open-flame method of continuously annealing non-ferrous wire developed by the Syncro Machine Company, Rahway, N. J. In that report, preliminary estimates of fuel consumption for the new-type units were made which have since been demonstrated by actual practice to be erroneous.

✦ ✦ ✦

SINCE May of this year the equipment in point has been made commercially available, and 28 of the new-type continuous open-flame annealing lines have been installed in five well-known wire mills. The results obtained on these lines differ significantly from the early estimates, and show a considerable economy in fuel (1) because there is no furnace to heat up or maintain at heat, (2) because the wire passes directly through the gas flames, and (3) because annealing time, labor and handling are materially reduced.

✦ ✦ ✦

NEXT month, (November) Wire and Wire Products will publish a complete paper analyzing the new open-flame wire-anneal equipment in detail, and those whose interest in the new-type apparatus has been spurred by preliminary information are urged to keep on the lookout for this first complete authentic report.

Reliability

When you select a source of supply for your manufacturers' wire, you insist on RELIABILITY.

For efficient production, your wire must be the right grade and possess the correct characteristics for the particular job it has to do. But this alone is not enough—these qualities must be UNIFORM.

Sheffield manufacturers' wire is custom-made to your exacting requirements.

Sheffield is a self-contained steel producing organization. Controlled quality starts in the open hearth furnaces. The steel is fitted to the job. It must pass Sheffield's exacting laboratory tests for chemical, physical, metallographical and metallurgical analyses. Uniformity is maintained by rigid inspection of every step in its manufacture.

Many manufacturers have standardized on Sheffield wire because its high quality and uniformity permit speedy, uninterrupted production.

You, too, will find Sheffield a reliable source of supply for your requirements.

Address Your Inquiries to Dept. W-4

SHEFFIELD STEEL CORPORATION
KANSAS CITY MISSOURI

INGOTS - BLOOMS - BILLETS - SHEET BARS - WELDED WIRE MESH - STRAND - WIRE RODS - PLATES - HOT ROLLED & GALVANIZED SHEETS - WIRE PRODUCTS - FENCE - RIVETS - MERCHANT BARS - SMALL SHAPES - TRACK SPIKES - TIE PLATES - RAIL STEEL & NEW BILLET REINFORCING BARS - FORGINGS - GRINDING MEDIA - BOLT & NUT PRODUCTS

New Steel Plant at Karabuk, Turkey, Opens

ERECTION of Turkey's first steel plant has been virtually completed at Karabuk, eighty miles north of Ankara, the capital, by British engineers, at a cost of $15,000,000.

✦ ✦ ✦

AT full capacity the works will produce annually 150,000 tons of steel structural shapes, including rails, sleepers, ties and railway accessories, and 25,000 tons of steel pipes of from 3 inches to 40 inches.

✦ ✦ ✦

THERE are thirteen chimneys, one of which, for the coke plant, is 260 feet high. The coke battery has forty-two ovens, the rolling plant shed is 1,000 feet long and no less than 1,000 tons of ore will be treated and 1,000 tons of coal consumed daily, every operation being mechanically controlled.

✦ ✦ ✦

SKILLED workers from Sheffield, Northampton, Middlesbrough, South Wales and Glasgow will operate the plant, most of them taking their families along. About 1,400 Turkish hands will be employed, which means the creation of an entirely new township for some 4,000 people.

✦ ✦ ✦

THE Karabuk Iron and Steel Works are not far from Zonguldak on the Black Sea, where sufficient coal for all their needs exists. They were to have worked iron-ore imported from abroad, for which purpose a special port was to be constructed at Catal Agzi, but since the scheme was embarked on an abundant local supply of iron-ore has been found.

✦ ✦ ✦

THE discovery was entirely accidental. Engineers prospecting for a railway line near Divriki reported that their compasses behaved erratically. The Mineral Research Institute followed the matter up and found hitherto unsuspected iron deposits of unusually rich iron content (68 per cent) in the vicinity.

New Alloy Makes Possible New Development in Fish Hooks

THE corrosion resistance of a non-ferrous alloy have been combined with the high mechanical properties of some of the heat treated alloy steels to make possible a new development in fish hooks, it has been announced by the Nickel Information Bureau.

✦ ✦ ✦

"Z" Nickel, the new heat treatable nickel alloy containing approximately 98 per cent pure nickel, has been used for these hooks. They are rust proof, even in salt water, and their mechanical properties after heat treating provide them with exceptional strength and stiffness without destroying required ductility.

✦ ✦ ✦

AT present the hooks have been produced entirely on an experimental basis, but their possibilities are being thoroughly investigated with an idea of beginning commercial production as soon as possible.

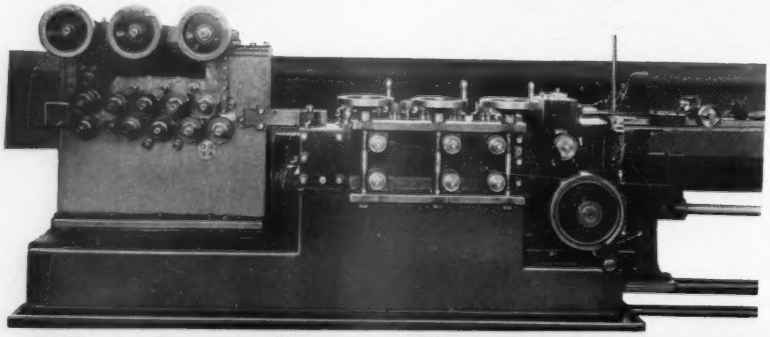
AUTOMATIC SHAPE STRAIGHTENER

with

FLYING SHEAR

for

Hexagon, Square and Rectangular Material



Will produce uniform quality rod without marking. Also high production, with accurate lengths.

THE HALLDEN MACHINE COMPANY

THOMASTON, CONNECTICUT

The Engineering of Continuous Strand Equipment

(*Continued from Page 563*)

ning a larger number of strands. The larger number of strands, from the design point of view means slower wire speeds, which in turn means a shorter unit. The shorter unit will then, in general, have a higher mean production than a longer unit handling the same wire sizes. With unusually short units, however, the advantage may be offset by increased floor space for reels and width of unit, as well as increase in length of take-up with added cost and greater inaccessibility to the workman.

✦ ✦ ✦

IT might be said further that the occurrence of interferences and troubles with the moving wire is more frequent with a greater number of strands and finer sizes. This feature, where calculations give a very large number of strands for very fine sizes, may well be a limiting factor in the number of strands that can be actually handled.

✦ ✦ ✦

Conclusion

IN presenting this discussion of strand treating equipment, no attempt has been made to lay down any laws to cover particular cases. The relations listed here may be applied equally well to any of the strand processes as a check of their efficiency. The process of patenting is so different from that of tinning that each deserves individual consideration of the basic laws governing it, and it is impossible to give them the detailed study they deserve, at this time. The intent has been rather to give an orderly presentation of a method of analysis, to emphasize the relations to be applied in the design of new equipment, and, finally, to show that sound engineering in all the elements in the operation of strand treating equipment leads to the greatest possible economy.

Simplified Practice Recommendation R45-39, Grinding Wheels, Now in Print

PRINTED copies of the fourth revision of Simplified Practice Recommendation R45, Grinding Wheels, are now available. This revision, which became effective June 1, 1939, is identified as R45-39.

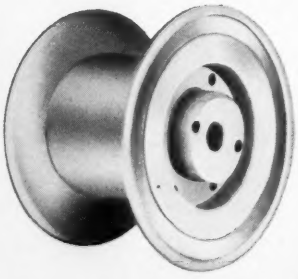
✦ ✦ ✦

THE recommendation lists the sizes and gives illustrations of the nine standard types of grinding wheels, the items included being representative of practically all grinding wheels used on standard makes of grinding machines. It is designed to simplify the stocking of wheels and to enable users accurately to order stock items.

✦ ✦ ✦

THE current revision brings the recommendation into line with present-day requirements through the elimination of some items which have fallen into disuse, and the addition of others for which the demand has become active in recent years.

FINE WIRE HIGH SPEED WIRE DRAWING SPOOLS



James Day (Machinery) Ltd.,
Sentinel House,
Southampton Row,
London, W. C. I, England.

MOSSBERG **PRESSED STEEL** CORP.

Announces a complete line of HEAVY DUTY PRECISION SPOOLS and REELS especially designed for high speed wire drawing and annealing.

The degree of efficiency obtained by the HIGH SPEED WIRE DRAWING MACHINE is largely dependent upon the accuracy and durability of the take-up spool.

The use of our PRECISION SPOOLS will increase your machine efficiency and eliminate your spool difficulties.

Complete range of sizes.

MOSSBERG PRESSED STEEL CORP

18 West Street,
ATTLEBORO, MASSACHUSETTS, U. S. A.

COMBINATION
500 lb. CAPACITY WIRE DRAWING — ANNEALING — STRANDING — REEL.

Woven-wire Screen Cloth Now Made in Peru

SENOR Manuel Cassado (Eabrica de Puerta 7 Tejido de Alambre), Malecon Rimac 288, Lima, a well-known manufacturer of folding doors and wire fencing is reported to have recently begun the manufacture of woven-wire screen cloth. By mid-May none of the new products had been offered for sale, but at that time Sr. Cassado was reported to be in Europe for the purpose of purchasing machinery with which to undertake the manufacture of screening on a large scale. Imported screening is described as in moderate demand in Peru. Imports in 1938 amounted to 92,687 kilos against 93,358 in 1937. Germany was the principal source of supply with shipments totaling 67,523 kilos, with Great Britain supplying 16,371 kilos and the United States 5,993 kilos in 1938.

✦ ✦ ✦

THE above mentioned Sr. Cassado is also the principal maker of woven-wire fencing in Peru and at this time together with Humphreys, S. A., Carabaya 428, Lima, produces the entire domestic output. The local product finds its chief use in river-defense work although considerable quantities are also used in the erection of tennis courts, etc. Imports, in 1939 amounted to only 29,969 kilos in comparison with 58,037 kilos the year preceding. Great Britain was the principal source in the later year supplying 10,182 kilos, with 8,113 kilos coming from Germany, 6,702 kilos from the United States and 4,103 kilos from Canada. Again, a fairly favorable outlook is presaged for this material. (Office of the American Commercial Attache, Lima).

✦ ✦ ✦

Offers Time Payments on Wire Fencing

MID-States Steel & Wire Company has put into effect a time payment plan for the purchase of steel fence by farmers. Buyers will be permitted to include all allied materials and accessories carried by Mid-States dealers, including hardware, paint and lumber.

✦ ✦ ✦

John R. Booher

JOHN R. BOOHER, 61, for the past 17 years advertising manager, Cleveland Crane & Engineering Co., Wickliffe, O., passed away in Kirtland, O., Aug. 15. Before that he was with the Leutkemeyer Co., Pittsburgh; Doubleday-Hill Electric Co., Pittsburgh; Westinghouse Electric & Mfg. Co., Pittsburgh and Cleveland, and the Cuyahoga Power Construction Co., Cleveland.

POSITION WANTED

25 years' experience drawing low and high brass wires, phosphor bronze, monel, nickel-silver, copper, etc. Last 12 years specializing fourdrinier wires. Experienced pot, bright or strand annealing tube furnaces. 20 years as supervisor of wire drawing plant. All necessary references furnished upon request. Address Box 310.

WIRE & WIRE PRODUCTS

Hubbard Spool Company

Extends Greetings to the Members of the

Wire Association

Welcome to Our City!

Hubbard Spool Company

1622 Carroll Avenue Chicago, Ill.

TELEPHONE SEELEY 1214

Pure Nickel Tube with Hole 1/3 Size of a Strand of Hair on Display at World's Fair

A PURE nickel tube with a hole so small that a strand of human hair could not pass through it has been placed on display at the Virginia State Exhibit at the New York World's Fair. It is believed to be the smallest metal tube ever produced and measures 26/10,000 of an inch in diameter. Its hole is about ⅓ this size and the thickness of the metal is 7/10,000 of an inch.

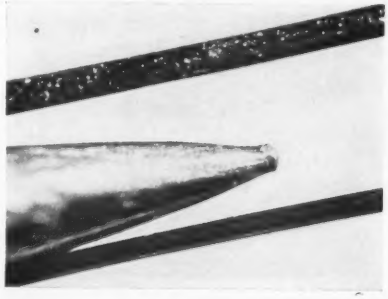
✦ ✦ ✦

MADE from pure nickel produced at Huntington, West Va., the tube was drawn down to its present dimensions by the Superior Tube Company, Norristown, Pa. Because of the almost microscopic size involved, the making of the dies taxed the craftsmanship of the most experienced die makers. Pure nickel was used in preference to ordinary steel or other metal subject to rusting because even a slight speck of rust might clog the tiny hole.

✦ ✦ ✦

IT is pointed out that a coil one pound in weight strung in a straight line would reach from the Trylon, around the peak of the Empire State Building and down to the Battery—a distance of approximately 11 miles.

✦ ✦ ✦

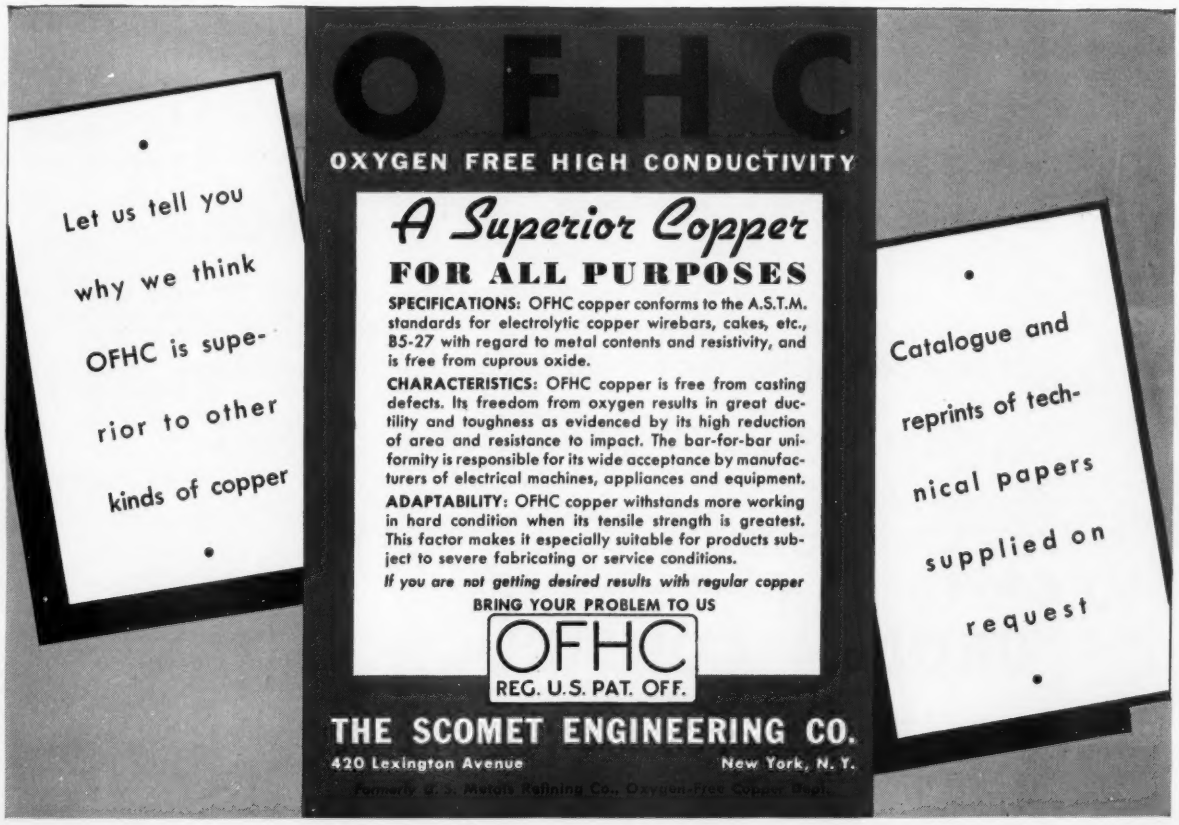


THE tube is displayed in a novel device known as the "Quadrylon", made of transparent material to a design suggested by the Trylon. Within the Quadrylon, the tube is submerged in oil. Air, forced through the tube, actually blows bubbles. Fifty pounds pressure is required to force air through the tube. The tube itself can barely be seen with the naked eye and magnifiers are provided for visitors. For purposes of comparison, a common pin is suspended by a strand of hair alongside the tube.

✦ ✦ ✦

PRODUCED especially for display purposes at the Fair, the tube as yet has no commercial applications, though tubes of slightly larger size are used in certain types of hypodermic needles and for various laboratory purposes. It was produced, however, with equipment used for the production of commercial tubing, no special equiment—except the dies—being required.

The Annual Convention of The Wire Association will be held at Chicago, Ill., October 23-27, 1939.


Let us tell you why we think OFHC is superior to other kinds of copper
OFHC
OXYGEN FREE HIGH CONDUCTIVITY
A Superior Copper
FOR ALL PURPOSES
SPECIFICATIONS: OFHC copper conforms to the A.S.T.M. standards for electrolytic copper wirebars, cakes, etc., B5-27 with regard to metal contents and resistivity, and is free from cuprous oxide.
CHARACTERISTICS: OFHC copper is free from casting defects. Its freedom from oxygen results in great ductility and toughness as evidenced by its high reduction of area and resistance to impact. The bar-for-bar uniformity is responsible for its wide acceptance by manufacturers of electrical machines, appliances and equipment.
ADAPTABILITY: OFHC copper withstands more working in hard condition when its tensile strength is greatest. This factor makes it especially suitable for products subject to severe fabricating or service conditions.
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'Round the World With the Wire Industry

German Notes

THE demand for wire machinery continues very lively. Shipment dates for wire drawing machines are 2 years hence in some cases. Wire nail machines require 6-8 months for shipment, wire netting machines up to 15 months, barbed wire machines 12-16 months. Only so-called "mass-articles" of wire machinery can be supplied in 3-4 months (wire rings, hooks, etc.) The demand for bolt, rivet, and nut machinery is very large also and shipment dates are often up to 15 months. Preference is given to high efficiency machines. Most of the German wire-bolt-rivet machinery works are operating at full capacity. On the export market the demand is equally heavy. Though the European markets take the bulk of shipments, many over seas countries are buying equally. For export shipment dates are about one half of what they are to domestic markets. The main buyers have been France, Great Britain, Sweden and the Balkan countries and Spain has just placed a large order for wire machinery in order to re-equip her national wire industry.

✦ ✦ ✦

GERMANY'S foreign trade in wires first half 1939 has been as follows: the import of wire rods was total 7.447 tons in 1939, as compared with 3.319 t in 1938, the export was 40.900 tons (16.153 in 1938). The main customers were Great Britain with 4.391 t (3.499), Sweden 4.315 (1.388), China 6.075 (1.298) tons. The import of bright wire amounted to total 2.513 tons (1.651 in 1938) of which Sweden supplied 1.798 tons (1.426). The total export of bright wire amounted to 34.919 tons (22.855), of which quantity Greece took 2.563 t (1.493), Holland 7.603 t (2.491), Russia 3.239 t (3.535) t, Brazil 2.287 (2.191) t and Chile 2.968 (847) tons. The import of galvanized, tinned wire, etc., was total 488 t, (607 in 1938), export 31.290 (19.463) tons. Of this export quantity 5.898 t went to Holland (2.957), 2.357 t to Norge (1.732), 2.191 t to Argentine (1.022), to Brazil 2.080 t (1.752) and to Uruguay 1.884 (1.611) tons.

✦ ✦ ✦

THE wire export trade was—as reported — quiet during the month of July. At present the demand is improving, as many buyers, fearing long shipment dates are buying now. It seems, that many orders placed at this time, are for renewing of emptied stocks. The situation in Latin-America is unaltered. The pressure of American competition is felt in Brazil, Venezuela and Colombia, but less in other markets and prices for these markets re-

STANDARD OR SPECIAL DESIGN MACHINES AND EQUIPMENT

FOR

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Strip Coilers — Cold Rolling Equipment — Rod Coilers
Galvanizing and Tinning Equipment — Scrap Bundling Machines
Wire Drawing Machines - - Continuous and for Fine Wire

Cotter Pin, Edging, Straightening and Cutting Machines
Cleaning and Pickling Equipment — Pointers — Swagers — Wire Frames
Wire Puller Tongs

High Grade Equipment at Present Day Prices — Your Inquiries Invited

BRODEN CONSTRUCTION CO.

ENGINEERS - - BUILDERS
Wire Mill and Cold Rolling Equipment
11730 Harvard Avenue — CLEVELAND

main consequently reduced. On all other markets no change of prices is to be noted. The July export volume was about 15% above last year, whereas in August business may probably surpass last year by 20-25%.

✦ ✦ ✦

THE demand for wire rods has increased and the official quotation of (gold) 5.50 for wire rods ¼" is easily maintained. Russia is buying mainly rod of thicker diameters and placed orders for considerable quantities. Rods in large coils were bought by the USA with an extra of s2/6 per ton. The best orders from Europe are the Rumanian, which are taking 1200 t per month. The German industry is however restricting her export business to not more than 6-7000 t as a maximum per month.

✦ ✦ ✦

THE Polish wire rod industry is now definitely a member of the International Wire Rod Cartel also for the works in the former Czek Silesian districts. The Polish industry has obtained an extra allotment for export amounting to 1500 tons per month. Scandinavia is the chief buyer.

✦ ✦ ✦

ESTONIA

Chicken Wire — Specified Quantity Exempted from Import Duty

THE Estonian Egg Export Monopoly and the Estonian Cooperative Wholesale Society have been authorized to import free of duty specified amounts of fence wire for building chicken yards, by a government decree of August 3, 1939, according to a report of August 5 from the American Consulate, Tallinn. This decree probably became effective immediately.

✦ ✦ ✦

THE exemption applies to 50,000 kilos of fence wire to be imported by the Egg Export Monopoly, and 5,500 kilos by the Cooperative Wholesale Society. It will be in effect until these importations are completed.

✦ ✦ ✦

Argentine Imports Lower

APRIL imports of tin plate, sheets, pipe and wire into Argentine—12,980 net tons—compare with 15,921 tons of these products received during March. Records show the United States to have supplied only 1,054 tons of the April total—27 tons of sheets and 1,027 tons of wire. British shipments, including 5,139 tons of tin plate, totaled 5,798 tons, while receipts from Belgium totaled 3,572 tons and those from Germany, 2,261 tons. (Office of the American Commercial Attache, Buenos Aires).

✦ ✦ ✦

British Output Up

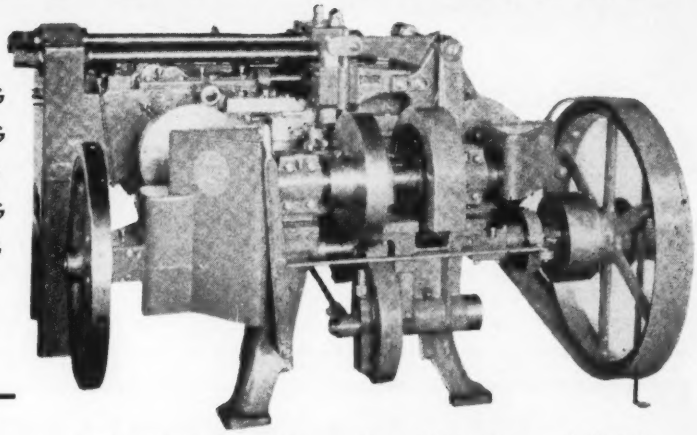
WRITING late in May the office of the American Commercial Attache at London commented that the British iron and steel industry had at that time entered into a phase of activity greater than that which obtained in 1937 when, be-

(*Please turn to Page 616*)

NILSON

AUTOMATIC PRESS AND FOUR SLIDE MACHINE

FOR SWAGING STAMPING PIERCING BLANKING FORMING OF COILED METAL



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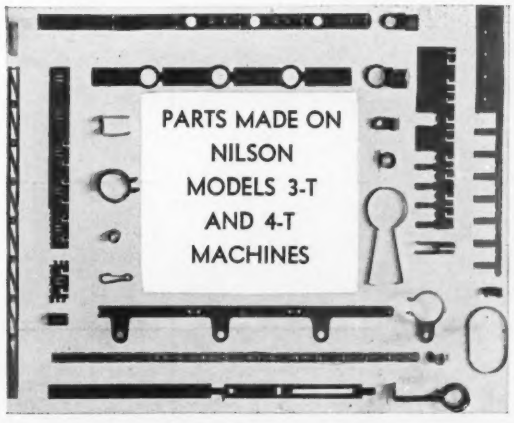
WE Build machines for forming Paper Clips, Buckles, Gate Hooks, Coat and Hat Hooks, Ceiling Hooks, Wire Ears, Cable Rings, Screw Eyes, Sash Chains, Automobile Side Chains, Flat Open Link Chains, Staples, Cotter Pins, Hose Clamps, Etc. and Wire Straighteners, Wire Reels, Frame Bending Machines and Special Presses.



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For Complete Details Address —

THE A. H. NILSON MACHINE CO.

BRIDGEPORT, CONN., U. S. A.

A Review of Recent Wire Patents

No. 2,168,037, MATTRESS, Patented August 1, 1939 by Max Marsack, Milwaukee, Wis., assignor, by mesne assignments, to Marsack Patents Corporation, Milwaukee, Wis., a corporation of Delaware.

The invention lies in the provision of a plyed cover pad over the ends of the wire coils of the mattress, with an outer fushion assembly, the innermost ply of the pad being secured to the wires.

✦ ✦ ✦

No. 2,168,340, METHOD OF AND APPARATUS FOR GROOVING WIRE, Patented August 8, 1939 by Charles K. Hill, Cleveland, Ohio, assignor to The Hillwood Manufacturing Company, Cleveland, Ohio, a corporation of Ohio.

A method of preparing the wire stock for spiral-grooved nails is provided and consists in continuously unwinding wire from a roll, imparting to the wire throughout its length a spiral groove, and winding the grooved wire on a drum having a tapered surface.

✦ ✦ ✦

No. 2,168,431, APPARATUS FOR MARKING STRANDS, Patented August 8, 1939 by John W. Olson, Hastings on Hudson, N. Y., assignor to Anaconda Wire and Cable Company, New York, N. Y., a corporation of Delaware.

This machine includes a rotatable disc bearing raised marking indicia and a co-operating idler pulley, the apparatus being actuated by drawing the strand to be marked between the marking disc and the idler pulley in a direction normal to the axis of rotation of the disc and means actuated by the rotation of the disc effective to move a pigmented strip across the face of the marking indicia in a direction parallel to the axis o rotation of the disc while the strip is not in contact with the strand, the pigmented strip being passed between spools in a direction parallel to the axis of rotation of the disc.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 300 Main St., Stamford, Conn.

✦ ✦ ✦

No. 2,168,957, MACHINE FOR THE WINDING OF THE ELECTRICAL COILS ON A RING-FORMED DYNAMO CORE, Patented August 8, 1939 by Ernst Kursteiner, Kjelsas, near Oslo, Norway.

In this machine, a wheel is provided of larger diameter than the dynamo coil, and adapted to be opened and passed through the core hole. Means is provided in the edge portion of the wheel to receive a quantity of electric conducting and insulating material, the wheel having openings in the circumference for the passage of the conducting and insulating material from the wheel towards the part of the core which is on the inside of the wheel.

✦ ✦ ✦

No. 2,169,129, MANUFACTURE OF FORMED WIRE, Patented August 8, 1939 by Edson W. Sawyer, Edgewood, R. I., and Ralph F. Gibbs, Norton, Mass., assignors to Laminated Metals Corporation, a corporation of Rhode Island.

This is a wire splitting apparatus for providing half round wire for spectacle frames and the like, where one surface is usually plated with gold or the like and the other surface is not plated. There are 8 claims.

✦ ✦ ✦

No. 2,169,159, MEANS FOR ACCURATE SCREW CUTTING, Patented August 8, 1939 by Georg Moller, Berlin-Neukolln, Germany.

Instead of providing a master spindle running parallel to the guide spindle of the machine disclosed in U. S. patent 2,125,584, this inventor provides a cylindrical longitudinal scale, having spiral lines, and on these lines are reflected by optical means on a diaphragm having an opening and a light sensitive cell behind the diaphragm so that valuations in the thread on the guide spindle from the master spindle causes an electro-

THE WATSON MACHINE COMPANY

ESTABLISHED 1845

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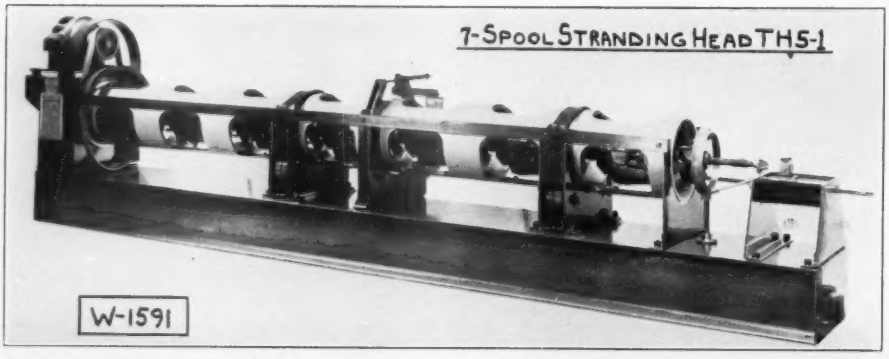
TUBULAR STRANDING MACHINES

Standard Sizes For From 5 to 1000 Pound Spools

Silent Support Rolls—All Steel Rotor—Vee Belt Drive—Electric Stops

7 Second Brakes



ELECTRICAL WIRE, CABLE & WIRE ROPE MACHINERY

Printed Literature Available On Considerable Of The Equipment Used In These Fields—Inquiries Are Invited

magnetic action for supplemental correction action of the feeding of the block.

✦ ✦ ✦

No. 2,170,830, WIRE FEED MECHANISM, Patented August 29, 1939 by Julius M. Minkow, New York, N. Y., assignor to Robert Minkow, Richmond Hill, N. Y.

This mechanism is of the class provided for forming and driving wire staples.

✦ ✦ ✦

No. 2,170,984, SPRING COILING MACHINE, Patented August 29, 1939 by Charles R. Bergevin and Elmer W. Halvorsen, Torrington, Conn., assignors to The Torrington Manufacturing Company, Torrington, Conn., a corporation of Connecticut.

The feed rolls are capable of intermittent rotation, with the coiling arbor and a coiling abutment controlled as to relative positions so as to successively cause the wire feeding into a coil.

✦ ✦ ✦

No. 2,171,119, STRAND-WINDING MACHINE, Patented August 29, 1939 by William A. Belits, Dumont, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York.

For winding wire strand about a closed core, the inventor provides a split (semi-circular) grooved ring with a flexible band fitting over the ring and covering the groove, for means to rotate the ring.

✦ ✦ ✦

No. 2,171,461, WATER - COOLED WIRE BLOCK, Patented August 29, 1939 by Carl E. Tideman, Worcester, Mass., assignor of one-half to Verner G. Anderson, Worcester, Mass.

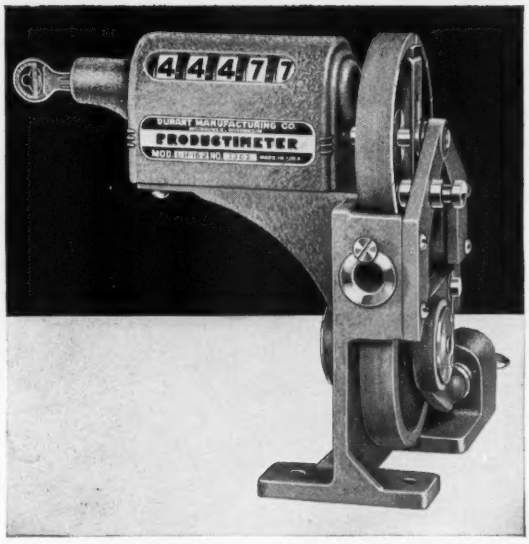
A wire block is provided rotatable about a vertical axis, the block having a rim about which a wire is coiled, means beneath the block having a recess for a pool of cooling fluid, and webs on the block and engageable with the fluid in the recess for directing cooling fluid against the rim as the block rotates.

✦ ✦ ✦

Submerged Heat by Submerged Combustion

(*Continued from Page 555*)

of Submerged Combustion burners. These advantages develop a total savings of about 50 per cent of present pickling costs. Faster pickling cuts labor costs at least in half. It speeds up production and also saves in acid, produces fewer rejects, and gives a more uniform, higher quality product for the customer. The remarkable savings enable the purchaser to write off the cost of the equipment in a very short time. One steel company has shown a savings of 97 cents per ton of steel pickled. It is possible to pickle one ton of steel rods at a fuel cost of five cents per ton using 1,000 B.t.u. gas at 50 cents per thousand cubic feet.



Durant Wire Measuring Machines

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Booth M304 National Metal Exposition

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Chicago Oct. 23-27

If You Measure Off Wire or Cable

Don't fail to inspect our booth in the Metal Exposition where we will exhibit a complete series of wire measuring machines, setting new standards in fast, accurate, lineal measuring of any kind of wire, wire rope, or cable from .005" dia. up.

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Shuster Universal Wire Reel

Angle Position

May be used in vertical or horizontal position. Can be set at any angle within 90 deg.

The F.B. Shuster Co.

NEW HAVEN, CONN.

Manufacturers Wire Straightening & Cutting Machinery Since 1866

CONTACT

✦ ✦ ✦

HAVE you a patent, a process or even a workable idea of value to the Wire Industry?

✦ ✦ ✦

THROUGH the services of a well-known wire and spring trades engineer, developments of definite value may be advantageously placed before interested prospects.

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REPRESENTATION on a straight fee or royalty percentage basis.

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ALL dealings will be held in the strictest confidence.

✦ ✦ ✦

BOX 112

WIRE & WIRE PRODUCTS

Stamford Trust Bldg.
STAMFORD, CONN.

Outstanding Personalities of the Wire Industry

(Continued from Page 598)

sales, and a member of the executive committee and board of directors, United States Steel Corporation of Delaware, effective Oct. 1, has been announced. Mr. Adams succeeds C. V. McKaig, who becomes assistant to president, with duties as may be assigned. Mr. McKaig continues as a member of the executive committee and board of directors.

✦ ✦ ✦

MR. ADAMS, the newly elected vice president, has spent his entire business career in the steel industry, having had several years of experience in steel mills in the Youngstown district and specializing in metallurgy before entering sales work. He first joined United States Steel subsidiaries in 1936 as manager of sales, sheet division, Carnegie-Illinois Steel Corporation, after having served as a sales executive with Trumbull Steel Company, Republic Steel Corporation and General Fireproofing Company. Since December 1, 1938, he has been vice president and assistant general manager of sales for Inland Steel Company. Mr. Adams is a graduate of Yale University and served in the United States Navy during the World War.

'Round the World with the Wire Industry

(Continued from Page 613)

cause of hitherto unprecedented demand, the output of steel ingots and castings reached 12,984,000 tons. Probably 1939 will not reach this total because of the poor showing of the earlier months, but there was no question of the extent of the demand in May. Orders for A.R.P. shelters had already taxed plants capable of producing the necessary materials to capacity—this demand to continue until at least all those entitled to free shelters should have been supplied. Doubling the Territorial Forces created an additional demand for certain grades of steel, while the demand for plates and other products required in shipbuilding may be expected to progressively increase in view of the numerous orders placed under the Government's proposals for assisting shipowners. As for specific items—the demand for sheets already exceeds the supply and orders for both sheets and sheet bars have been placed abroad. Scrap supplies are getting low and steel makers have been forced to use more pig iron. This, in turn, caused 17 additional blast furnaces to be brought into operation during the first three months of the year—12 of these turning out pig of steel making grades.

FOR	THE CLEANING HOUSE . . . . . HOT GALVANIZING ROOM . . . . . ELECTRO GALVANIZING ROOM . . .
Hot or Cold Muriatic • Hot or Cold Sulphuric • Abrasion Resistance •	DURIRON and DURICHLOR EQUIPMENT Centrifugal Pumps—standard and self-priming. Valves—"Y", Angle, Check, Quick-Releasing, Duriron-Nordstrom lubricated. Tank Outlets—Heating Coils for Cleaning Tubs—Pipe and Fittings for Acid Handling—Acid Resisting Tank Fittings—Pickling Crates—Yokes—Heat Exchangers—Heating Jets. WILL REDUCE COSTS, SAVE TIME, IMPROVE RESULTS *Write for bulletins on acid handling equipment* **The Duriron Company, Inc.** 445 N. FINDLAY ST. DAYTON, OHIO

Violin Bow Made of Stainless Steel

THE New York Times reports that after ten years of experimenting, during which time he availed himself of the knowledge of scientists and musicians, as well as the experiences of generations of craftsmen in his family, Joseph Primavera, violin maker of this city, has produced a bow with stainless steel "hairs."

✦ ✦ ✦

MR. PRIMAVERA and others have, from time to time, tried various metals for "hairs" in bows. The conventional bow is made up of some 110 selected hairs from the tails of Siberian horses. Silver, aluminum, steel (ordinary), and other metals were all tried without success. Finally Mr. Primavera had made some special alloy stainless steel wire, or "hair," one two-thousandths of an inch in diameter.

✦ ✦ ✦

APPROXIMATELY 150 of these stainless steel "hairs" are used for each bow, instead of the usual 110 horse-tail hairs. Strangely enough, the stainless steel "hairs" weigh only one-third as much as the natural horse hairs.

✦ ✦ ✦

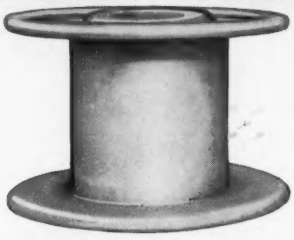
THE stainless steel "hairs" are uniform in their microscopic roughness, and the laboratory that draws these "hairs" can furnish a much more uniform product than can nature in natural horse hair. One of the secrets in the success of the new bows is the perfection of a finer rosin with which to treat them.

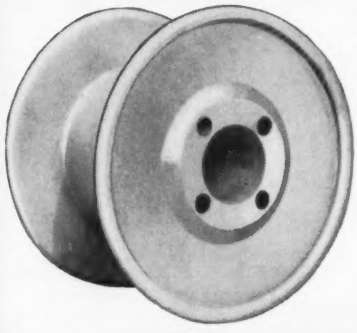
✦ ✦ ✦

Hazard Wire Rope Issues New Catalog

THE Hazard Wire Rope Division of the American Chain and Cable Company, Inc., Wilkes-Barre, Pa., announce the publication of a new catalog on wire rope, their No. 20. This catalog is virtually a pocket-sized handbook on wire rope as it contains information of a practical and technical nature in addition to list prices and specifications of the various constructions of wire rope. A copy will be sent to wire rope users on request.

FOR HIGHEST SPEEDS





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STEEL REELS

The reels that are engineered to the job... designed and built by the company that originated the steel reel idea . . . are the reels you should be using in your plant. Every year, more and more Apco Mossberg Steel Reels are bought by quality-minded buyers throughout the wire industry.

FREE

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Without obligation to you, Apco Mossberg engineers will be glad to study your reel problem, and supply complete suggestions, drawings, blue prints. Write for information today.

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TESTING, Measuring and Reeling Equipment for the Wire, Hose, Rope and Sheet Insulation Industries.

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LET us demonstrate to you, the method of testing Wire Sparkers, now in use in Great Britain under the new British standards for Spark Testing.

✦ ✦ ✦

A REVOLUTIONARY development in Measuring Machines shown for the first time at the Show.

BE SURE TO SEE IT.

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AVOID THE COSTLY REPLACEMENT PROBLEM

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SECURE RESULTS OF SUCCESSFUL EXPERIENCE

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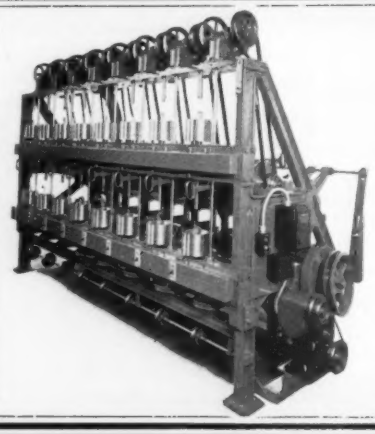

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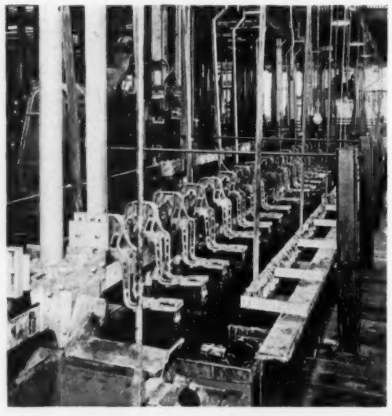
Standard Steel Spring Company Has World's Largest Nickel Plating Tank

THE Standard Steel Spring Company has recently completed the largest nickel plating tank in the world. The operating volume of the new tank is 27,500 gallons. The tank is fabricated of $\frac{3}{8}$ inch steel plate lined with $\frac{1}{4}$ inch of rubber. The inside dimensions of the tank are: length 67 feet 7 inches; width 6 feet 10 inches; depth 8 feet 3 inches. The weight of the nickel anodes in the tank is 33,000 lbs. The total value of the solution and the anodes is about $26,000.00. The temperature of the solution is automatically controlled and the solution is continuously filtered. The connected generator capacity is 25,000 amperes at 6 volts. This tank is used in nickel plating automobile bumpers.

✦ ✦ ✦



THE Standard Steel Spring Company has also recently introduced a new pore-free coating, "Corronite". Data on this pore-free metallic coating will be made available for the first time at the Metal Show in Chicago, October 26-30. This coating greatly exceeds the corrosion resistance of present coatings and compares favorably in cost with present commercial coatings and thus will open up many new applications for tonnage steel.

This is an invitation for you to become a member of The Wire Association. ✦ ✦ ✦ ✦ ✦ ✦

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RODINE, added to the pickling bath, saves acid and metal, minimizes brittleness, and lowers pickling costs. Standard the world around.

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New Bulletin on Farrel-Sykes Gear Generating Machine

EXECUTIVES and engineers of plants using or making gears will find a great deal of helpful information in the new bulletin No. 442, just issued by Farrel-Birmingham Company, Inc., Buffalo, New York.

✦ ✦ ✦

THIS bulletin describes in detail the latest type of Farrel-Sykes gear generator for generating gears up to 25″ diameter and explains the advantages the machine offers for high speed production of precision herringbone gears and other types of gears used for connecting parallel axes. The bulletin also describes the features of design and its precision construction which make the machine practically noiseless even when operating at high speed, at the same time enabling it to generate high precision gears rapidly and economically and to improve the accuracy of commercial gears without increasing their cost.

✦ ✦ ✦

THE new bulletin describes automatic features of the machine which reduce the operator's work to placing a blank in position, pressing a starting button and removing the gear after the teeth are cut, permitting him to attend two to four machines. It also contains tabulations giving specifications and capacities of the 2-C and other sizes of Sykes gear generators.

✦ ✦ ✦

THE bulletin is handsomely printed in three colors on coated paper and contains many photographic illustrations of different types of gears that can be produced on the machine, as well as details of the machine itself and diagrams showing various methods of generating different types of gears.

✦ ✦ ✦

BULLETIN 442 will be found useful by plant executives and engineers facing problems relating to gears and their generation. Complimentary copies will be sent on application to Farrel-Birmingham Company, Inc., 344 Vulcan St., Buffalo, New York.

GET COMPLETE LUBRICATION WITH NOPCO 2261

Nopco 2261 is a new departure in tube drawing compounds. Its extremely high neutral fat content—50%, insures correct and adequate lubrication, even in cases where heavy draws with large reductions are made.

Nopco 2261 is highly versatile, being equally effective in the wet drawing of:

Any size copper or brass tubes.
Large copper or brass shells, rivets, etc.
Heavy copper or brass wire.

Nopco 2261 is a superior lubricant. It is formulated of high titre vegetable fats—is readily soluble. It may be depended on to aid production and to effect economies in your drawing operations.

Write for Technical Data Bulletin, or better still, order enough for a trial—see for yourself.

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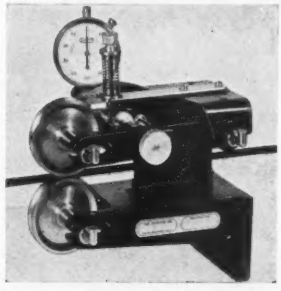

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Also makers of COMTOR WATCHMAN, a device which flashes warning signal when wall thickness goes above or below desired limits.

Request Bulletin 26

THE COMTOR CO.

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Learn about PARALAN

Paralan will give your finished wire and wire products protection from atmospheric corrosion in the mill and in shipping. Paralan-coated wire can be spot welded or soldered without cleaning. Also, Paralan leaves surfaces in good condition for all types of finishes—enameling, japanning, lacquering, plating, etc.

Write for further information. We may be able to solve your difficulties.

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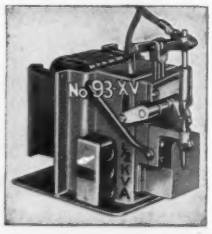
Foot Operated



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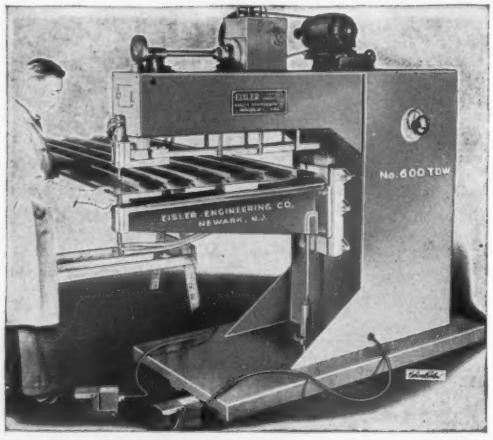

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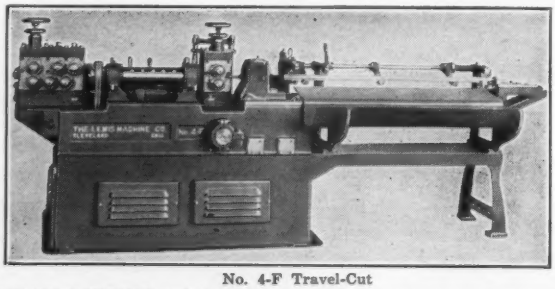
— Automatic—High Speed—Heavy Duty —



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Wire Drawing Diamond Dies

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Wire dies by Wayne embody all the essentials necessary (quality stones — experienced workmanship — the most rigid of inspection) to assure accuracy plus long-life at high speed. Try Wayne dies today—see for yourself why drawers of wire acclaim *"Wayne the best die value obtainable."*

Wayne Wire Die Co., Inc. 57 SHERIDAN ST., IRVINGTON, NEW JERSEY

War Spending Goes to Heavy Industries

IN analyzing the effects of Federal spending for defense, Poor's Stock Reports points out that money spent by the Government under the present emergency would go more to heavy industries than to consumer industries, which have been the major benefactors of New Deal spending programs of past years.

✦ ✦ ✦

INCREASING orders would accrue to the steel industry. A greater demand would arise also for the nonferrous metals. Building materials would be needed in large quantities. Railroad traffic would rise, as would the demand for electric power, for petroleum and coal.

✦ ✦ ✦

PRODUCTION of aircraft, already at peak levels, would be still further increased. War preparedness would call for substantial governmental expenditures for heavy chemicals, for industrial machinery of most all types, and for trucks.

✦ ✦ ✦

"DESPITE the initial shock, the near-term implications of a general European war are bullish, so far as they apply to the outlook for domestic business activity," states the analysis. "The long-term outlook, so far as the ultimate effects are concerned, could not be blacker. It might well mean the end of European civilization as we know it. However, the only constructive policy possible for the investor is to accept conditions as they unfold, and to profit if possible by shorter-term developments. As has been the case in the past, selling of securities on the break of the war news is likely to involve more risk of loss than following a policy of retention.

✦ ✦ ✦

"IT is too early to determine accurately the effects of war on earnings of different corporations. Much will depend upon the policies which develop in Washington. Future steps in the direction of taxing corporate earnings will have a significant bearing on profit pos-

sibilities from war business. Profit margin restrictions on Government orders given under contract will also be important. Governmental restrictions on business enterprise will naturally increase, but this does not mean that business must be profitless."

✦ ✦ ✦

Power Driven "Turks Head" Announced

TO those producing some rectangular stock and special shapes, the development of a Power Driven "Turks Head" with a power drive on all four rolls will prove most interesting.

✦ ✦ ✦

THIS development has just been announced for both the universal and plain type of "Turks Head" and complete details can be obtained by writing the Standard Machinery Company, Providence, Rhode Island.

✦ ✦ ✦

War Demand Puts Off Machine Tool Show

MACHINE tool builders feel that "the greatest contribution the industry can make to the welfare of the nation at this time is to concentrate their entire efforts on the production of the greatest possible number of machine tools," Wendell E. Whipp, president of the National Machine Tool Builders Association, declared in announcing that the group has decided to postpone indefinitely the Machine Tool Show, which was to have been held at Cleveland, Oct. 4 to 13.

✦ ✦ ✦

"THE immediate effect of the war is a quickened demand for all of the products of industry," Mr. Whipp pointed out. "While every one is conscious of the demand for munitions, the embargo will eliminate that factor in the present situation. However, it has been estimated that munitions were only 10 per cent of our exports during the World War, and the greatest burden by far that will fall on American industry is to furnish the normal needs of nations who have been trading with the countries now at war and who can no longer be served by them."

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SUCCESS DEPENDS ON INCREASED PRODUCTION AND DECREASED COSTS

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Centerless Grinding and Polishing Machine

This entirely new machine grinds and polishes in one operation shafting, drill rods, etc.; highly polished surface, great accuracy and unusually large output.

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✓ WEAVING	✓ CLIP	✓ BOOKBINDING
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45-47 Adams Street

Guttenberg, New Jersey

Exports and Imports of Wire

(*Continued from Page 599*)

dominant factor in the 3,873-ton trade in spiegeleisen supplying 3,868 tons, while Belgium's 1,732 tons made up the greater part of the 2,318 tons of cotton ties imported, and Norway, 1,322 tons, and the Netherlands, 475 tons, accounted for the bulk of the 1,985 tons of ferro-manganese received.

✦ ✦ ✦

CARD Clothing: 26,332 square feet, $38,408 (24,830 square feet, $38,024); United Kingdom 21,020 square feet, $29,751; Canada 3,642 square feet, $5,193; Belgium 1,420 square feet, $2,784.

✦ ✦ ✦

Wood Screws

EXPORTS of iron and steel wood screws during July, 1939, totaled 5,671 gross valued at $1,048. Of this total, Canada took 1,538 gross valued at $233; Mexico, 1,335 gross valued at $196; Ecuador, 945 gross valued at $116; Dominican Republic, 620 gross valued at $150; Colombia, 291 gross valued at $57; New Zealand, 280 gross valued at $51; Cuba, 210 gross valued at $139; Panama, Canal Zone, 190 gross valued at $32.

✦ ✦ ✦

EXPORTS of brass wood screws during the same month totaled 9,930 gross valued at $3,808. Of this total, Philippine Islands took 3,747 gross valued at $1,441; Panama, Canal Zone, 2,338 gross valued at $851; Mexico, 1,469 gross valued at $634; Argentina, 1,200 gross valued at $408; Bermuda, 510 gross valued at $192; Costa Rica, 172 gross valued at $97; Venezuela, 130 gross valued at $26.

✦ ✦ ✦

IMPORTS of wood screws during the same month totaled 1,200 gross valued at $80, and were supplied by Canada, 1,000 gross valued at $27, and the Netherlands, 200 gross valued at $53.

NEW 99% SOAP INSURES CORRECT LUBRICATION

Nopco's new Soap LX has been prepared especially for the dry drawing of steel wire. Its superiority is due to its actual soap content—99% active dry soap.

Because of this high pure soap content, Nopco Soap LX possesses plus values that will effect economy in your drawing operations.

Free from glycerine, salt or fillers of any kind, Nopco Soap LX insures correct lubrication with longer die life, better finish and higher yields per pound of soap.

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6—Lewis Welding Wire S & C Machines M. D.
2—Shuster Shaped Wire S & C Machines ½" & ⅞"
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Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

BORON CARBIDE—
Norton Co., Worcester, Mass.

BORTZ—Diamond
Smit, J. K. & Sons, Inc., New York, N. Y.

CARRIERS—Braider, High Speed
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CEMENT FLOOR CLEANER—
Magnus Chemical Co., Garwood, N. J.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Magnus Chemical Co., Garwood, N. J.
Monsanto Chemical Co., Akron, Ohio.
Parkin Co., The Wm., Pittsburgh, Pa.

CLEANERS—Hand and Metal
Magnus Chemical Co., Garwood, N. J.

CLEANING & PICKLING EQUIPMENT—
Broden Construction Co., Cleveland, O.
Duriron Co., The, Dayton, O.
Morgan Construction Co., Worcester, Mass.
Nukem Products Corp., Buffalo, N. Y.
Vaughn Machinery Co., Cuyahoga Falls, O.

CLOTH TESTERS—
Scott, Henry L., Co., Providence, R. I.

COATING—Protective
American Lanolin Corp., Lawrence, Mass.
National Oil Products Co., Harrison, N. J.

COILS—Steam
Heil & Co., Cleveland, Ohio.

COILERS—Sheet, Strip and Wire
Broden Construction Co., Cleveland, O.
Conran, Fred M., Newark, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

COILERS AND SPOOLERS FOR INSULATED WIRES—
Entwistle, James L., Pawtucket, R. I.

COLD HEADERS—
Ajax Manufacturing Co., Cleveland, Ohio.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

COPPER—Electrolytic
Scomet Engineering Co., New York, N. Y.

COPHOLDERS—Steel
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CRANES—Wire Mill
Cleveland Tramrail div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUSTOM WIRE DRAWING—
Hy-Carbo Steel Co., Lowell, Mass.

DIAMOND POWDERS—
Smit, J. K. & Sons, Inc., New York, N. Y.

DIAMOND TOOLS—
Rusch Wire Die Corp., New York, N. Y.

DIES—Diamond
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Cochaud Wire Die Co., New York, N. Y.
Globe Wire Die Co. (M. V. Dreyspool), New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Inc., Irvington, N. J.

DIES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Cochaud Wire Die Co., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Inc., Irvington, N. J.

DIES—Rod and Tube Drawing
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Globe Wire Die Co. (M. V. Dreyspool), New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tantalum Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tungsten Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Globe Wire Die Co. (M. V. Dreyspool), New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DRAW BENCHES—
Conran, Fred M., Newark, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

DRUMS—Flange Steel
Stevens Metal Products Co., Niles, O.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

ELECTRIC IMMERSION FOR PICKLING—
Heil & Co., Cleveland, Ohio.

ENGINEERS—Consulting Wire Mill
Hartley, George D., Worcester, Mass.
Lewis, Kenneth B., New York, N. Y.

EQUIPMENT—Insulation Testing
Entwistle, James L., Pawtucket, R. I.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FILLERS—Paper for Cable
E. W. Twitchell, Inc., Phila., Pa.

FLASH BAKER—
Carl-Mayer Corp., The, Cleveland, Ohio.

FURNACES—Annealing
Carl-Mayer Corp., Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Lee-Wilson Engineering Co., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

FURNACES—Automatic
Carl-Mayer Corp., Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Lee-Wilson Engineering Co., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Brazing
Electric Furnace Co., Salem, O.
Firth-Sterling Steel Co., McKeesport, Pa.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, O.
Lee-Wilson Engineering Co., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

FURNACES—Electric
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Galvanizing
Lee-Wilson Engineering Co., Cleveland, Ohio

FURNACES—Hardening and Tempering
Carl-Mayer Corp., Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Lead Melting
Electric Furnace Co., Salem, O.
John Robertson Co., Brooklyn, N. Y.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Non-Oxidizing
Carl-Mayer Corp., Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Normalizing
Carl-Mayer Corp., Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Salt Bath
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Wire, Strip & Sheet
Carl-Mayer Corp., Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

GALVANIZING EQUIPMENT—
Lee-Wilson Engineering Co., Cleveland, Ohio
Meaker Co., The, Chicago, Ill.

GEARS—Wire Mill
Farrel-Birmingham Co., Ansonia, Conn.

GRINDERS—Roll
Farrel-Birmingham Co., Ansonia, Conn.
Norton Co., Worcester, Mass.

HOISTS—Electric Travelling
Cleveland Tramrail div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

INHIBITORS—
American Chemical Paint Co., Ambler, Pa.
Monsanto Chemical Co., Akron, Ohio.
National Oil Products Co., Harrison, N. J.
Parkin Co., The Wm., Pittsburgh, Pa.

INSTRUMENTS—Electrical
Comtor Co., The, Waltham, Mass.
Entwistle, James L., Pawtucket, R. I.

INSULATION — Cable or Cable Filler
E. W. Twitchell, Inc., Phila., Pa.

JETS—Steam
Heil & Co., Cleveland, Ohio.

LATHES—Die Reaming
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LEAD—Pig
St. Joseph Lead Co., Josephtown, Beaver County, Pa.

LIME—
Warner Company, The, Bellefonte, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Magnus Chemical Co., Garwood, N. J.
National Oil Products Co., Harrison, N. J.
Vanco, Co., The, Manchester, Conn.

LUBRICANTS—Wire Drawing
Magnus Chemical Co., Garwood, N. J.
National Oil Products Co., Harrison, N. J.
Vanco, Co., The, Manchester, Conn.

MACHINERY — Armoring (Cable, Wire Hose)
American Insulating Mach'y. Co., Phila., Pa.
Conran, Fred M., Newark, N. J.
New England Butt Co., Providence, R. I.
John Robertson Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

MACHINERY—Braiding
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Bunching
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Mach'y. Co., Phila., Pa.
Conran, Fred M., Newark, N. J.
Entwistle, James L., Pawtucket, R. I.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Conran, Fred M., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Coilers
Broden Construction Co., Cleveland, O.
Conran, Fred M., Newark, N. J.
Entwistle, James L., Pawtucket, R. I.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
New England Butt Co., Providence, R. I.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cold Heading with Wire Drawing Attachment
Ajax Manufacturing Co., Cleveland, Ohio.

MACHINERY—Copper Wire Drawing and Rolling
Conran, Fred M., Newark, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Covering Wire
Fidelity Machine Co., Philadelphia, Pa.
Sinfra Corp., The, Jersey City, N. J.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Cutting
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Schuyler, W. A., New York, N. Y.
F. B. Shuster Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Die Making
Firth-Sterling Steel Co., McKeesport, Pa.

MACHINERY—Enameling
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine, Rahway, N. J.

MACHINERY—Extruding
John Robertson Co., Brooklyn, N. Y.
Royle, John & Sons, Paterson, N. J.
Schuyler, W. A., New York, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, O.
Conran, Fred M., Newark, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Forming
Central States Industrial Engineers, DeKalb, Ill.
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Galvanizing
Lee-Wilson Engineering Co., Cleveland, Ohio

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Conran, Fred M., Newark, N. J.
Lee-Wilson Engineering Co., Cleveland, Ohio
Meaker Co., The, Chicago, Ill.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
Conran, Fred M., Newark, N. J.
Fidelity Machine Co., Philadelphia, Pa.
H. J. Ruesch Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
National Rubber Machinery Co., Akron, O.
New England Butt Co., Providence, R. I.
Sinfra Corp., The, Jersey City, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Knitting
Fidelity Machine Co., Philadelphia, Pa.
Sinfra Corp., The, Jersey City, N. J.

MACHINERY—Lead Encasing Presses, etc.
John Robertson Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Magnet Wire
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Material Handling
Cleveland Tramrail div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

MACHINERY — Measuring Wire & Cable
Comto.' Co., The, Waltham, Mass.
Durant Mfg. Co., Milwaukee, Wis.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works Co., Chicago, Ill.
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Paper Covering Wire
Terkelsen Machine Co., Boston, Mass.

MACHINERY—Pointing
Broden Construction Co., Cleveland, O.
Conran, Fred M., Newark, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, O.
Conran, Fred M., Newark, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, O.
Conran, Fred M., Newark, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Syncro Machine, Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Rubber for Insulating Wire
Farrel-Birmingham Co., Ansonia, Conn.
National Rubber Machinery Co., Akron, O.

MACHINERY—Rubber Strip Covering
Farrel-Birmingham Co., Ansonia, Conn.
National Rubber Machinery Co., Akron, O.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
Farrel-Birmingham Co., Ansonia, Conn.
National Rubber Machinery Co., Akron, O.
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Special — Combination Machine for Drawing, Cutting to Length, Straightening and Reeling Bars from Coil in One Operation (Shumag Type)
Schuyler, W. A., New York, N. Y.

MACHINERY—Special
American Insulating Mach'y. Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
Central States Industrial Engineers, DeKalb, Ill.
Conran, Fred M., Newark, N. J.
National Rubber Machinery Co., Akron, O.
New England Butt, Co., Providence, R. I.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spooling
American Insulating Mach'y. Co., Phila., Pa.
Conran, Fred M., Newark, N. J.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
Conran, Fred M., Newark, N. J.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Schuyler, W. A., New York, N. Y.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Stranding
Conran, Fred M., Newark, N. J.
National Rubber Machinery Co., Akron, O.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

MACHINERY—Strip Steel
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Swaging
Conran, Fred M., Newark, N. J.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine, Rahway, N. J.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y. Co., Phila., Pa.
Conran, Fred M., Newark, N. J.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing
Comtor Co., The, Waltham, Mass.
Entwistle, James L., Pawtucket, R. I.
Scott, Henry L., Co., Providence, R. I.

MACHINERY—Testing Size of Wire
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Testing Thickness of Wire
Comtor Co., The, Waltham, Mass.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Weaving Wire
Central States Industrial Engineers, DeKalb, Ill.

MACHINERY—Welding Wire
Eisler Engineering Co., Inc., Newark, N. J.
Micro Products Co., Chicago, Ill.
F. B. Shuster Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Winding
American Insulating Mach'y. Co., Phila., Pa.
Conran, Fred M., Newark, N. J.
Entwistle, James L., Pawtucket, R. I.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
Actna Standard Engineering Co., Youngstown, Ohio.
American Insulating Mach'y. Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
Conran, Fred M., Newark, N. J.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Schuyler, W. A., New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Wire Measuring
Durant Mfg. Co., Milwaukee, Wis.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Rope
National Rubber Machinery Co., Akron, O.
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Wood Screw
National Machinery Exchange (Used), New York, N. Y.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

MACHINERY—Wrapping Wire
Terkelsen Machine Co., Boston, Mass.

MILLS—Tandem Rolling and Edging
Torrington Mfg. Co., The, Torrington, Conn.

MOTORS—Electric
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

OVENS—Industrial
Carl-Mayer Corp., Cleveland, Ohio.

PACKING—Tannate Leather
Rhoads & Sons, J. E., Philadelphia, Pa.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Insulating
E. W. Twitchell, Inc., Phila., Pa.

PAPER TESTERS—
Scott, Henry L., Co., Providence, R. I.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COILS AND JETS — Steam
Heil & Co., Cleveland, Ohio.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Monsanto Chemical Co., Akron, Ohio.
National Oil Products Co., Harrison, N. J.
Parkin Co., The Wm., Pittsburgh, Pa.

PIPING AND FITTINGS—Acid Resistant
Duriron Co., Inc., The, Dayton, O.
Heil & Co., Cleveland, Ohio.

PLASTIC TESTERS—
Scott, Henry L., Co., Providence, R. I.

POTS—Lead Melting
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Hydraulic and Mechanical
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

RECORDERS—Fault and Reel
Entwistle, James L., Pawtucket, R. I.

REEL AND TENSION STAND—
Fidelity Machine Co., Philadelphia, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Corp., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Steel
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Corp., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS AND SPOOLS—Shipping and Shop
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Corp., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

REELS—Takeoff
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Vulcanizing and Impregnating
Apco Mossberg Corp., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Wire Drawing
Apco Mossberg Corp., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio.

RODS—Wire—Non-Ferrous
American Brass Co., Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., Seymour, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.
Sheffield Steel Co., Kansas City, Mo.
Wheeling Steel Corp., Wheeling, W. Va.

ROLLS—
Farrel-Birmingham Co., Ansonia, Conn.

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott, Henry L., Co., Providence, R. I.

RUST PROOF COMPOUND—
American Lanolin Co., Lawrence, Mass.

SHEET—Steel
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, Ohio.
Wheeling Steel Corp., Wheeling, W. Va.

SKIN PROTECTOR—
Magnus Chemical Co., Garwood, N. J.

SOAPS—Industrial and Wire Drawing
Magnus Chemical Co., Garwood, N. J.
National Oil Products Co., Harrison, N. J.
Vanco, Co., The, Manchester, Conn.

SPARK TESTING EQUIPMENT—
Entwistle, James L., Pawtucket, R. I.

SPOOLS—Annealing and Wire Drawing
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Corp., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Chicago, Ill.

SPOOLS—Shipping and Shop
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Corp., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

SPOOLS—Steel
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Corp., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

STAMPINGS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

STEAM COILS AND JETS — For Acid Tanks
Heil & Co., Cleveland, Ohio.

WHERE TO BUY, Continued

STRIP—Brass and Non Ferrous
American Brass Co., Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

STRIP—Steel
Bethlehem Steel Corp., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.

STRIP METAL TESTERS—
Scott, Henry L., Co., Providence, R. I.

SWIFTS—Take-off
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

TAKE-UPS FOR CABLE, HOSE, LEAD PRESSES AND SHEET RUBBER—
Entwistle, James L., Pawtucket, R. I.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TANKS—Pickling
Heil & Co., Cleveland, Ohio.

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

TENSILE TESTERS—
Scott, Henry L., Co., Providence, R. I.

TESTING INSTRUMENTS—
Comtor Co., The, Waltham, Mass.
Entwistle, James L., Providence, R. I.
Scott Co., Henry L., Providence, R. I.

TRAMRAIL SYSTEMS—
Cleveland Tramrail div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS—
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS—
H. J. Ruesch Machine Co., Newark, N. J.

TURKS HEAD—
Standard Machinery Co., Auburn, R. I.

VALVES AND FITTINGS—Acid Proof
Duriron Co., The, Dayton, O.
Heil & Co., Cleveland, Ohio.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y. Co., Phila., Pa.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.
Sheffield Steel Co., Kansas City, Mo.
Wheeling Steel Corp., Wheeling, W. Va.

WIRE DRAWING—High Grade Custom
Hy-Carbo Steel Co., Lowell, Mass.

WIRE—Electric
American Brass Co., Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Enameled For Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.
Sheffield Steel Co., Kansas City, Mo.
Wheeling Steel Corp., Wheeling, W. Va.
Wickwire Bros., Cortland, N. Y.

WIRE—Nickel Silver and Phosphor Bronze
American Brass Co., Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Non Ferrous to Specification For Special Purposes
American Brass Co., Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Seymour Mfg. Co., Seymour, Conn.
Sheffield Steel Co., Kansas City, Mo.

WIRE—Stainless Steel—
Firth-Sterling Steel Co., McKeesport, Pa.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Republic Steel Corp., Cleveland, O.
Pittsburgh Steel Co., Pittsburgh, Pa.
Sheffield Steel Co., Kansas City, Mo.
Wheeling Steel Corp., Wheeling, W. Va.
Wickwire Bros., Cortland, N. Y.

WIRE AND STRIP—Zinc
Metal Industry Works, Poland.
Platt Bros. & Co., The, Waterbury, Conn.

WIRE TESTERS—
Scott, Henry L., Co., Providence, R. I.

WIRE, WEAVING—Non Ferrous
American Brass Co., Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.

YARN TESTERS—
Scott, Henry L., Co., Providence, R. I.

ZINC—Slab
St. Joseph Lead Co., Josephtown, Beaver County, Pa.

Statement of Ownership

Statement of ownership, management, circulation, etc., required by the Act of Congress of August 24, 1912 and March 3, 1933, of Wire & Wire Products published monthly at Washington, N. J., for October 1, 1939.

State of Connecticut, County of Fairfield, ss.: Before me, a Notary Public in and for the State and county aforesaid, personally appeared Richard E. Brown, who, having been duly sworn according to law, deposes and says that he is the President of Wire & Wire Products and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Quinn-Brown Publishing Corporation, 300 Main St., Stamford, Conn.; editor, Richard E. Brown, 300 Main St., Stamford, Conn.; managing editor, none; business manager, R. S. Spengel, 300 Main St., Stamford, Conn.

2. That the owner is: (if owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Quinn-Brown Publishing Corporation, 300 Main St., Stamford, Conn.; Jennie R. Baker, Hammonton, N. J., and Leta B. Brown, of 300 Main St., Stamford, Conn.

3. That the known bondholders, mortgagees, and other security holders owning or holding one per cent of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

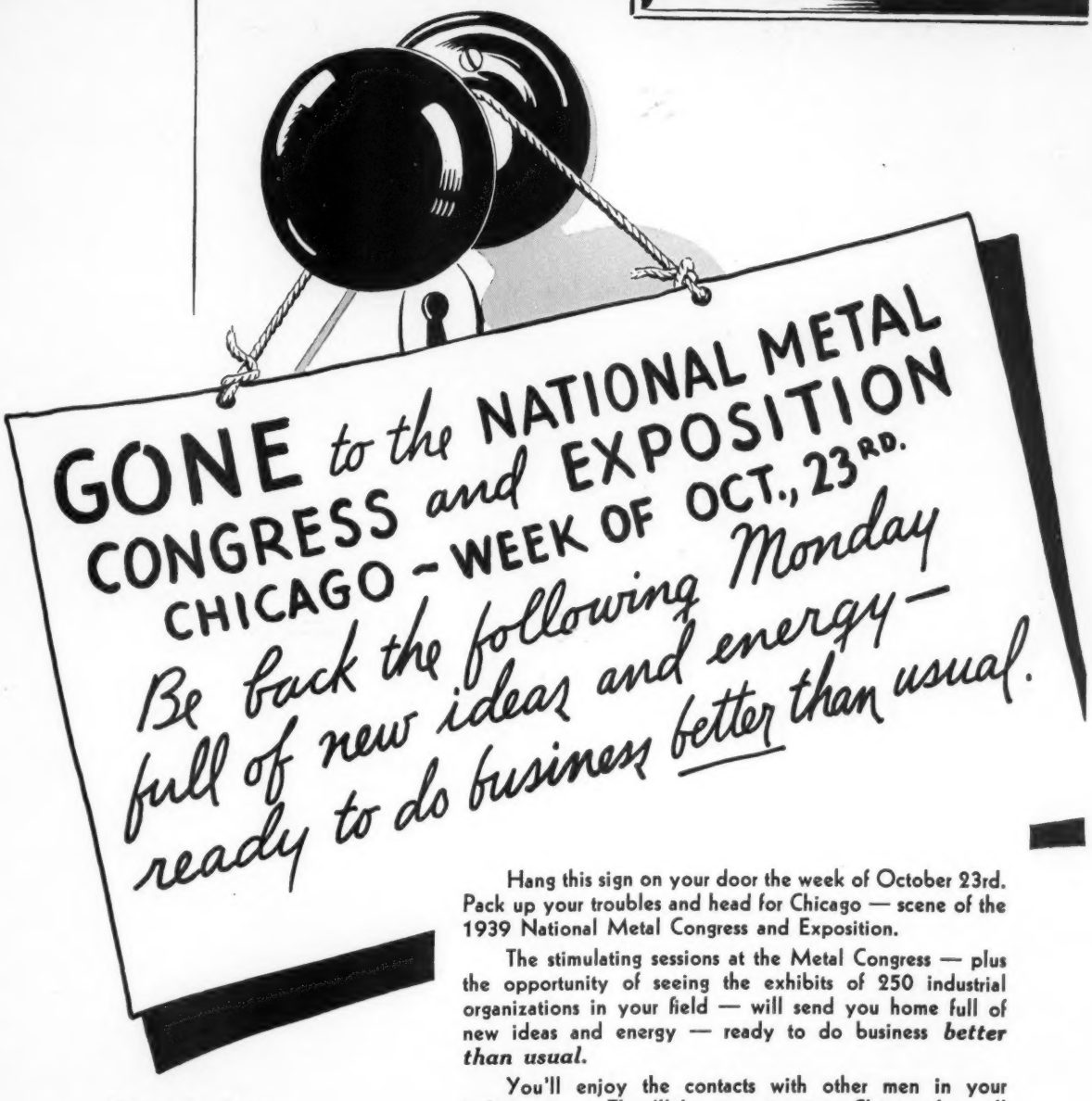
4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

RICHARD E. BROWN
(President)

Sworn to and subscribed before me this 22nd day of September, 1939.

(SEAL) JAMES A. WEIR,
Notary Public.

Mr. SMITH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Co-operating Societies:
Wire Association;
American Society for Metals;
Institute of Metals Division and
Iron and Steel Division of A.I.M.E.;
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National
METAL CONGRESS *and* EXPOSITION
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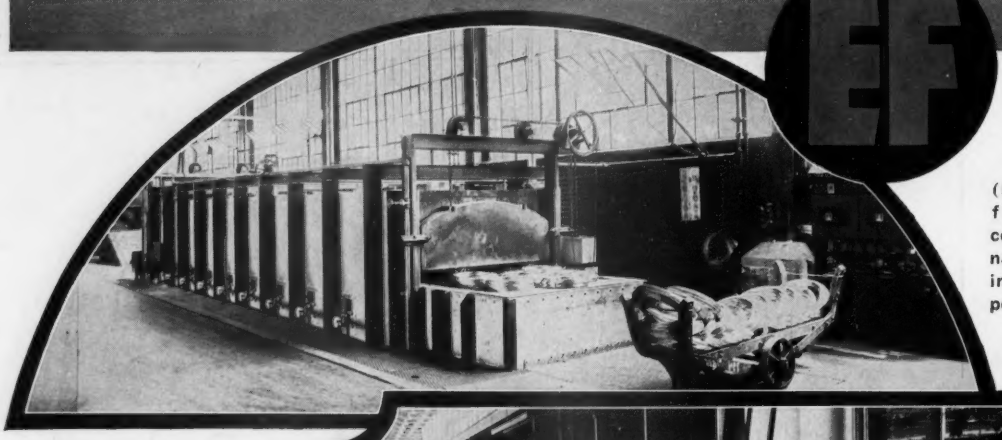
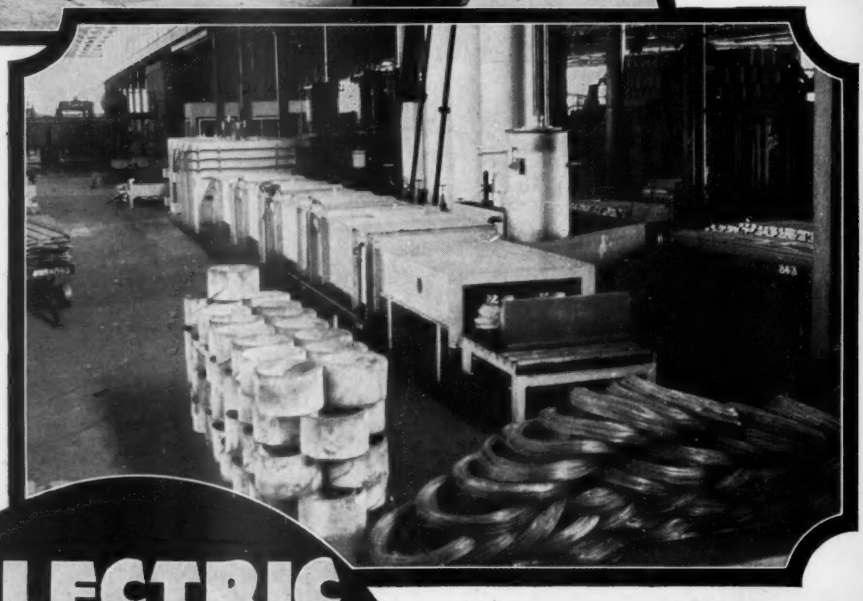


(Left) An E F gas fired continuous conveyor type furnace, clean annealing 5000 lbs. wire per hour.



(Right) An E F special atmosphere electric furnace for bright annealing wire and strip—continuously.

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